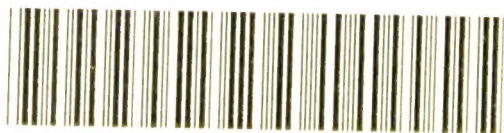


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HOLMES'
SURGERY

A TREATISE ON
SURGERY

ITS PRINCIPLES AND PRACTICE

By T. HOLMES, M.A. CANTAB.

CONSULTING SURGEON TO ST GEORGE'S HOSPITAL
MEMB. ASSOCIÉ DE LA SOC. DE CHIR. DE PARIS

WITH FOUR HUNDRED AND TWENTY-EIGHT ILLUSTRATIONS

'Mille mali species'

FIFTH EDITION

EDITED BY

T. PICKERING PICK

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PREFACE

TO

THE FIFTH EDITION.

IN this edition the general arrangement of the work remains unchanged, with the single exception that the chapter on Diseases of the Eye has been entirely omitted. This has not been done without considerable thought; for though it was stated in the first edition of this work, that 'a knowledge of the main principles of diagnosis and treatment ought to be possessed by every surgeon, in the case of disease of the organs of the special senses quite as much as those of the rest of the body,' still it was felt that this branch of Surgery has been so greatly modified by recent discoveries that it could only be taught by one actively engaged in ophthalmic practice, and then very inadequately in the limited space which could be devoted to it in this work. It was judged better, therefore, to exclude this branch of Surgery altogether and to refer the student to the many excellent treatises on Ophthalmic Surgery which are now available for his use. This omission was rendered the more necessary, as otherwise the additions and alterations which have been made in other sections would have largely increased the bulk of this work, which, without the chapter on Diseases of the Eye, somewhat exceeds in volume the last edition.

In other respects the endeavour of the Editor has been to bring the work up to the standard of our present state of knowledge of Surgery without in any way altering the general character of the work. Amongst the subjects in which the former edition has required the most extensive emendation and alteration are Inflammation;

Wounds and their treatment; Tumours; Diseases of the Bones and Joints; Abdominal Surgery and Intestinal Obstruction; and Diseases of the Breast. The operative treatment in reference to cerebral localisation has also been discussed, as far as our present knowledge of the subject permits.

In committing this edition to the judgment of the surgical profession, the Editor trusts that he is not too presumptuous in hoping that it will be found as much deserving of its confidence as former editions have proved themselves to be.

PREFACE

TO

THE FIRST EDITION.



I NEED say little by way of preface to this volume, which, indeed, speaks for itself. It is an attempt to represent the present condition of Surgery, as it is practised in this country, by a treatise which shall be not unworthy to rank with the other excellent text-books in use in our schools. I have intended this book to be to some extent an introduction to the more elaborate ‘System of Surgery’ of which I am the editor, and have freely used the treatises of that System in composing the various chapters; and when any quotations are made the source of which is not distinctly acknowledged, it will be understood that they are taken from thence. At the same time I have not servilely followed the teaching even of those authorities; and I hope the reader will find throughout the book sufficient evidence of that personal experience of the various exigencies of surgery which can alone justify an author in attempting the difficult task of writing on the general subject of surgical theory and practice. The task is indeed difficult. It is not only the immense number of topics, and the endless details of all of them—though necessarily some of these topics must be less familiar to any single surgeon (however wide his experience) than others are, and though it is hardly possible but that some of the details should escape the writer’s attention—but, added to this, the necessary conditions of space press hardly on the writer of a surgical text-book. Though this volume extends to over 900 pages, the space allotted to each topic only permits of a brief and, I fear, far too meagre account of each, and leaves hardly any room at all to discuss varying opinions and rival

suggestions of practice. My endeavour has been to give a plain and practical account of each surgical injury and disease, and of the treatment which is most commonly advisable. For the minuter details of pathology I must refer the reader to some of the many admirable works on that subject; and for fuller disquisitions on treatment either to the essays in the 'System of Surgery' or to the authors quoted in the text and referred to in the index of authors.

I have to acknowledge with grateful thanks the liberality with which the rich store of material contained in the museum and case-books of St. George's Hospital has been put at my disposal. It is, of course, from the school of this hospital, in which I have studied and practised surgery for over a quarter of a century, that my illustrations and my teaching have been chiefly drawn; but I have not neglected the teaching of other British schools; nor, although I have intended this work to be an exposition especially of British surgery, have I failed to refer, as far as my information and my space allowed, to the works of American and Continental surgeons.

For the illustrations I have been indebted mainly to Dr. Westmacott, to whom my warm thanks are due for the great interest he has taken in the work and the pains he has spent upon it. Many of the minor illustrations were, however, drawn by one of my pupils, Mr. F. D. Drewitt, whose intelligent and able assistance it is my duty to acknowledge as it deserves; nor must I omit to thank Mr. Evans, the engraver of the woodcuts, for the great care which he has bestowed upon them, and for several of the diagrams which he has drawn under my direction.

I have thought it necessary to comprise in this treatise all the diseases which are included under the title 'surgical,' so that chapters will be found on diseases of the eye, ear, and skin. In treating the first-mentioned subject I have availed myself of the able assistance of my colleague Mr. Carter; as it is many years since I have personally engaged in ophthalmic practice, and it is only from recent practice that a branch of surgery can be taught which has been so greatly modified by recent discoveries. But I hold that a knowledge of the main principles of diagnosis and treatment ought to be possessed by every surgeon in the case of diseases of the organs of the special senses quite as much as those of the rest of the body. Among the many injuries which the

curse of specialism has inflicted equally on the profession and the public, not the least has been the neglect of the diseases of these organs which some practitioners and many students seem almost to regard as natural. I am happy to think that in the subject of ophthalmic surgery my readers will have the benefit of so competent a guide as Mr. Carter. The chapter on Diseases of the Ear is necessarily very short, and is intended only to point out the leading facts in Aural Surgery, and those methods of treatment with which every practitioner ought to be familiar. I must express my obligation to Mr. Dalby, who has been so kind as to peruse it and correct some of its most obvious defects.

I must now submit this book to the judgment of my professional brethren, though fully conscious of its many imperfections. I fear that as we advance in life we feel more and more the difficulty of coming up to our own expectations in any enterprise of importance, and the truth of the old saying, ‘*Quid tam dextro pede concipis ut te conatus non pœniteat votique peracti?*’

GREAT CUMBERLAND PLACE :

October 1875.

Errata.

Page 80, line 18, for *negrogenica* read *necrogenica*

„ 534, footnote ⁴, line 6, for *Delpach* read *Delpech*

„ 653, lines 8 and 9, for *ichthyosis* read *ichthyosis*

„ 747, lines 7, 6, and 3 from bottom, for *Mr. Lister* read *Sir Joseph Lister*

„ 793, footnote, for *Land's oil* read *Lund's oil*

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SURGERY:

ITS PRINCIPLES AND PRACTICE.

CHAPTER I.

INFLAMMATION AND THE PROCESS OF UNION IN SOFT PARTS— TRAUMATIC FEVER—DRESSING OF WOUNDS.

INFLAMMATION is the name given to a perverted vital action, the leading features of which are the production of 'redness, swelling, heat and pain'¹ in the part.

These symptoms depend upon *congestion*, or the loading of the inflamed part with blood; and this congestion is spoken of in surgical language as *active*, i.e. due to an increased supply, or *passive*, i.e. due to diminished power of circulation or impeded return of blood. As congestion forms an essential part of all inflammatory processes, it will be convenient here to consider it somewhat in detail, before proceeding to the consideration of the phenomena of inflammation, as it will assist in clearing up what will have to be said on this subject. At the same time it must be borne in mind that congestion, and especially *passive* congestion, is by no means always, nor indeed usually, an inflammatory condition. Any cause which prevents the return of the venous blood—a ligature round the limb, a tumour in the course of the vein, even prolonged standing or exposure to heat, besides innumerable other similar conditions—may determine passive congestion. While, at the same time, determination of blood, or active congestion, as in blushing, the turgescence of erectile organs, or the afflux of blood to the salivary glands during mastication, is an element in thousands of the actions of daily life, and can scarcely therefore be considered a disease. Similarly it may be said with respect to many of the phenomena of inflammation, and even with respect to inflammation itself, that it is very difficult, if not impossible, to draw an accurate limit between health and disease. Exudation of the plasma of the blood almost certainly takes place as a physiological process, and exudation of the leucocytes very probably does so. Inflammation itself is only vital action perverted by some injury; and who is to say where the limit is between the injuries which are and those which are not compatible with health?

Congestion.

Active congestion, active local hyperæmia, determination of blood, may be

Active congestion.

¹ This is Celsus's definition: 'Notæ inflammationis sunt quatuor, rubor et tumor, cum calore et dolore.'

defined as a condition in which there is an increased quantity of blood in a part, flowing with increased rapidity. If, for instance, a grain of dust be lodged on the eye, red vessels will be seen shooting over parts which before were perfectly white, denoting a sudden afflux of blood to the part. Or if some irritant be applied to the web of a frog's foot, when viewed under the microscope, the small arteries will be seen to dilate and the stream of blood to flow more rapidly. This is active congestion, or determination of blood to a part. It is a vital action, and is often very transitory; the dilated vessels almost immediately recovering their normal calibre, and the blood current slowing down to its normal rate of progress. It is, as has been stated, an element in thousands of the actions of daily life, and occurs in those conditions where a sudden increase of blood is required for some physiological purpose. Thus, a morsel of food is introduced into the mouth, requiring an increased quantity of saliva for its insalivation; immediately an active congestion of, or determination of blood to, the salivary glands takes place, causing a more active secretion and an increased flow of saliva. It is, however, frequently associated with disease, and is involved in most surgical processes, forming an essential element in inflammation. In disease, active congestion is produced by the application of some irritant, which may act in two separate ways, viz., either in a reflex manner by stimulating the sensory nerves of a part, or by paralysing the muscular coats of the blood vessels and so causing them to dilate. The muscular coats of the blood-vessels are supplied by the vaso-motor sympathetic nerves, and it is known that any irritation of a sensory nerve will by reflex action produce an inhibition of the vaso-motor nerves of the vessels in the area supplied by that nerve, and so an immediate dilatation of the vessels and a determination of blood. Or, on the other hand, any irritant sufficiently powerful to injuriously affect the coats of the vessel, may paralyse their muscle cells and so cause a dilatation and an increased flow of blood.

The symptoms of active congestion are those which we should expect to find in a part in which there is an increased quantity of blood flowing with increased activity. The blood being in greater quantity there is necessarily swelling, and flowing with greater rapidity it parts with but little oxygen in its passage through the capillaries, and there is therefore redness of a bright scarlet hue. There is also a sensation of fulness and heat in the part, and its functional activity is increased.

Passive
congestion.

Passive congestion, or passive hyperæmia, may be defined as a condition in which the blood in a part is increased in quantity, but flows with diminished rapidity, and is consequently of a darker colour than natural. It is a purely mechanical condition, and may exist quite independently of inflammation; but at the same time it may be a direct outcome of the inflammatory process, or, on the other hand, may act as a powerful predisposing cause of inflammation.

The phenomena of mechanical passive congestion may be best studied by applying a ligature to a part, say a finger, sufficiently tightly to obstruct the return of blood through the veins, without arresting its flow through the arteries. If the ligature were applied more tightly so as to arrest the circulation through the arteries and veins simultaneously, complete *strangulation* would occur, and no visible changes would take place until gangrene and decomposition commenced. But in the case where the ligature is less tightly applied, so that the flow through the arteries is not arrested, whilst the return through the veins is stopped, the blood in the affected area necessarily becomes greatly increased in quantity, until all the vessels of the part

become turgid with blood, which of course flows more and more languidly, until, if the circulation through the veins is entirely arrested, complete stoppage takes place and 'stagnation' is said to have occurred. In consequence of its prolonged stay in the capillaries, the blood becomes more and more deoxidised, and is therefore of a darker colour than natural. In a less degree of constriction of the veins, where some of the blood is still able to find its way from the part through them, a less intense condition exists, and stagnation does not necessarily occur, but the same condition of dilated and turgid vessels with diminished movement exists. In order to relieve the vessels of this excess of fluid, an exudation of the more watery constituents of the blood takes place into the perivascular spaces, so that they become distended with serous fluid, constituting the condition known as *œdema*. Sometimes also the corpuscles of the blood pass through the walls of the vessels without visible rupture, though in some cases of intense congestion, rupture of the capillaries may take place and minute hæmorrhages into the surrounding tissues ensue. The red corpuscles thus freed from the vessels, either with or without rupture, become disintegrated and absorbed, leaving behind them, however, some of their pigment, which remains as a brown discolouration, which may be seen in a typical form in the legs of old people who have been the subjects of long-continued congestion from varicose veins.

The mechanical causes which lead to passive congestion are, first, anything which obstructs the return of the venous blood; thus the pressure of a tumour on a vein, the long-continued dependent position of a part, the force of gravity, or the plugging of a vein by a thrombus, may all conduce to the production of a passive congestion. Again, it may be caused by a lessening of the normal forces of the circulation, as in diminution of the propulsive power of the heart from the debility of old age or after certain exhausting fevers. Or, lastly, it may be produced by anything which obstructs the flow of blood through the arteries; so that though these vessels are able to supply sufficient blood to the affected area, there is not enough pressure from behind to drive the blood onwards through the veins, and consequently partial stagnation takes place.

The symptoms of passive congestion are such as one expects to find in a part in which there is excess of blood, flowing languidly, and of a darker colour than natural. If a ligature be fairly tightly applied round a finger, it will be seen to become immediately swollen, the swelling soon becoming soft and pitting from *œdema* having taken place; it will assume a dusky red hue, becoming after a lapse of time dark red to purple; there will be a sensation of a dull aching pain in the part, and the temperature will probably soon fall below the normal standard, but at all events it will never be found to be above the natural heat of the part.

In a part which has long been the seat of passive congestion, the functional activity is diminished and the vitality lowered, rendering it liable to ulcerate from slight causes. The tissues may also be found to be indurated and brawny from the growth of fibroid tissue around the vessels, which by its pressure on the normal structures may cause their atrophy.

Passive congestion as seen in inflammation appears to be the result of an altered vital relation between the walls of the capillaries and small veins and their contained blood, and will be considered more in detail in discussing the phenomena of inflammation.

Inflammation may be said to be a combination of active and passive congestion. It is an *active* congestion, inasmuch as, upon the application

Definition
of inflam-
mation.

of an irritant to a part sufficient to cause inflammation, there is a dilatation of the small arteries, the stream of blood flows more rapidly, and the dilatation extends to the capillaries and then to the veins; and secondly it is a *passive* congestion, because the stream of blood shortly begins to move more slowly, and then oscillates and stops entirely.¹ It has been said above that it is a vital action perverted by some injury, but we may go further than this and say that inflammation consists not in an increased but in diminished vitality of the tissues affected, so that any irritant, not sufficiently intense to kill a part, manifests itself by retardation of the circulation and by those subsequent extravascular changes which make up the process of inflammation. A consideration of this doctrine, which was first enunciated by Professor Lister in 1858, and the discovery by Cohnheim of the mechanism of exudation, led Dr. Burdon Sanderson in 1876 to formulate his celebrated and probably almost universally accepted definition of inflammation. 'Inflammation is the aggregate of those results which manifest themselves in an injured part as the immediate consequences of the injurious action to which it has been exposed.'² Of course, in such a definition the word 'injury' is taken in its widest sense, not limited to traumatic injury, and it is understood that the 'injury' is not of such a nature as to destroy at once the vitality of the part.

The path-
ology of in-
flamma-
tion.

Our knowledge of the phenomena which take place in inflammation is for the most part derived from experiment. The inflammatory process is artificially produced by the application of some irritant to some transparent tissue of a living animal placed under the microscope. For this purpose the web of a frog's foot is the most convenient, but other tissues, as the wing of a bat or the mesentery of a rabbit, may be used for this purpose. If we examine the normal circulation in the frog's web, we note the corpuscles flowing in a continuous stream from the arteries, through the capillaries, into the veins. The velocity is greatest in the arteries, and slowest in the capillaries. In the minute arteries, which are smaller than their accompanying veins, a faint pulsation, synchronous with the heart's action, may occasionally be observed; but in the capillaries and veins the flow is a steady one, so that it is impossible to tell when the systole of the heart takes place. In the smallest capillaries the corpuscles may be seen flowing in single file, and without showing any tendency to adhere to each other or to the wall of the vessel. But in the larger capillaries and small arterioles, where it is possible for several corpuscles to run abreast, the coloured corpuscles will be found to be collected in the centre of the channel forming an *axial stream*, while at the sides of the channel, between the central stream and the wall of the vessel, there is a space in which there are no red corpuscles, and which is known as the 'inert layer.' In this layer white corpuscles may frequently be seen, moving slowly along, and often in jerks, showing a tendency to cling to and adhere to the sides of the vessel. If now an irritant be applied to the part, dilatation of the arteries takes place, and the blood stream flows with increased rapidity. In some instances this dilatation is preceded by a momentary contraction or shrinking of the vessel, depending apparently upon the nature of the irritant employed to excite the inflammation. But the period of contraction is exceedingly transient, and,

¹ Dr. Burdon Sanderson says 'the employment of the word determination should be strictly limited to the primary acceleration of the blood-stream in and about an injured part, and should not be so extended as to comprise the subsequent inflammatory congestion.'—'Lancet,' vol. i. 1876, p. 108.

² 'Lancet,' vol. i. 1876, p. 150.

as far as is known, possesses no practical bearing. The dilatation of the arteries continues progressively, until in some cases they become as large as, or larger than, their accompanying veins. This is followed by a corresponding dilatation of the capillaries and then the veins. And we have now, as the first stage of the inflammatory condition, all the vessels of the part dilated and the blood flowing through them with increased velocity, or, in other words, *active hyperæmia*. This condition, however, does not last long; we soon begin to note a slowing of the blood stream, so that, whereas in the first stage it was impossible to differentiate one corpuscle from another on account of the velocity of the current, it is now possible to recognise individual corpuscles. In some instances, where the irritant applied has been very powerful, this condition of dilated vessels with slowed blood stream is the first thing noticed; the increased velocity has been so transitory, and has been so rapidly followed by the slowing of the stream, that it will have taken place before the microscope can be brought to bear on the object. This slowing of the blood current is due to the fact that the corpuscles acquire a tendency to adhere to each other and to the walls of the vessels. This adhesiveness is first manifested in the white corpuscles. If a single corpuscle in the 'inert layer' be attentively watched, it will be seen to move slowly along in the course of the current, presenting a peculiar oscillation from apparently clinging every now and then to the wall of the vessel, then oscillating and again becoming free and moving somewhat farther in the course of the circulation and again becoming attached. These periods of arrest become more and more prolonged, and the course of the corpuscle slower and slower, until eventually it becomes entirely arrested. More and more of the white corpuscles fall out of the axial stream, until the inert layer becomes crowded with them, so that sometimes, especially in the small veins, they form a complete layer adhering to the walls of the vessels. During this time the red corpuscles still flow on in the axial current, but after a time the same adhesiveness manifests itself in these structures and they begin to adhere to each other, first in the veins and capillaries, then in the arteries; the circulation becomes slower and slower, and eventually altogether arrested. The vessels are now choked with stagnant corpuscles, and a condition known as 'inflammatory stasis' ensues.

Considerable doubt still exists as to the cause of this peculiar adhesiveness which the corpuscles develop. It would appear, however, to be most probably due to some changes in the tissues, as the result of the irritant that has produced the inflammation, which cause the corpuscles, when they are brought into contact with this altered tissue, to adhere together. It cannot be due to changes in the corpuscles themselves, for as they pass out of the inflamed area they lose again this peculiar property which they exhibited whilst flowing through the injured part. The experiments of Sir Joseph Lister throw some light upon this subject. He has shown that in a state of health the lining membranes of vessels present no tendency to encourage coagulation in the blood brought in contact with them, but that when the walls of the vessels are diseased there is this tendency, and the blood behaves as if it were in contact with any ordinary solid. A somewhat similar condition may be imagined to have occurred in inflammation:—that is to say, the irritant, whatever it may be, has produced such a change in the tissues that the corpuscles, when they pass into the injured area, acquire a tendency to adhere; behave, in fact, in the living body as if they were in contact with dead matter.

The second stage in the inflammatory condition is one in which we find the dilated vessels choked with corpuscles, arrest having taken place, 'stasis' having occurred. It is right here to mention that this condition of 'stasis' must not be confounded with 'thrombosis.' In the former condition there is no formation of fibrine and therefore no coagulation of the blood, and should the irritant which caused the inflammation be slight and transitory, the condition may gradually pass off; the corpuscles lose their adhesiveness, recover their powers of movement and flow on in the course of the circulation, and the normal condition is entirely restored. In thrombosis, on the other hand, coagulation has actually taken place. If the irritant which produced the inflammation be of a more severe nature or is prolonged, the stasis also is prolonged, and the corpuscles being deprived of all nutrition inevitably perish. Disintegration of some of the white corpuscles takes place, setting free their para-globulin and fibrine ferment, which, acting upon the fibrinogen of the liquor sanguinis which remains between the corpuscles in the choked area, causes the formation of fibrine and the coagulation of the blood, or thrombosis, to take place.

The third change in the inflammatory process consists in the exudation of liquor sanguinis and corpuscles. The exudation or 'emigration' of the white corpuscles or leucocytes is a very remarkable phenomenon, which, though not in the first instance actually demonstrated by Cohnheim, was by him first accurately described and its importance in reference to the pathology of inflammation pointed out. The experiment by which this emigration may be actually demonstrated is very difficult to carry out successfully. The mesentery of a frog is best suited for the purpose. If this be exposed and prepared for examination, and a small vein, in which the white corpuscles have arranged themselves in a layer in the manner above described, be watched, it will be seen that the wall of the vessel exhibits buds or projections, as if the leucocytes were pushing their way through. If an individual corpuscle be now selected and carefully watched, it will be seen that this bud or projection steadily increases in size, and as it does so, the corpuscle within the vessel correspondingly diminishes. This continues until the whole of the corpuscle has disappeared from the interior of the vessel, and a body, formed from the bud or projection and exactly resembling the original corpuscle, is seen on the outside of the vessel, still connected by a sort of tongue or string. This then gives way, and we have a free body in the parenchyma external to the vessel, exactly similar to a leucocyte; but the wall of the vessel shows no alteration at the part where the leucocyte has thus passed through it. (See Fig. 1.) These bodies display the same amœboid movements after their emigration which the leucocytes are known to do within the vessels, and which seem to be connected with their further development. If, however, a too powerful stimulant be applied, it will stop the amœboid movements both without and within the vessels. The precise manner in which the corpuscles pass through the wall of the vessel is not accurately determined. Formerly it was believed that there were openings or 'stomata' in the capillary wall, through which the corpuscles pass, and some authors still teach that, though no definite openings are now believed to exist, the corpuscles pass out between the cells of which the vessel wall is made up, and the adhesion of which to each other is lessened as the result of the inflammatory process. It is conceivable, however, that another explanation may be offered, that the leucocyte, which is a mass of protoplasm, rebuilds the wall of the vessel that it is perforating (which is

also a mass of protoplasm) as fast as it destroys it. As the intensity of the inflammatory process increases, we find the red corpuscles also beginning to pass out of the vessels, apparently simply as the result of intra-vascular pressure, and not, like the leucocytes, in consequence of an inherent power of active movement in themselves. This emigration of the coloured corpuscles is observed for the most part in the capillaries only. At the same time that this emigration of the corpuscles is going on, another important change is taking place; the fluid contents of the blood-vessels are also passing out, as the result apparently of intra-vascular pressure which forces the fluid constituents of the blood through the leaky walls of the blood-vessels, damaged by the inflammation. This fluid, unlike the serum which filters through the walls of healthy vessels as the result of passive congestion (see page 3), is not only very rich in albumen, but also contains fibrinogen, and this, brought into contact with para-globulin, set free by the disintegration of some of the emigrated leucocytes, under the influence of the fibrin ferment, coagulates in the tissues. In the act of coagulation it entangles in its meshes the remainder and greater part of the emigrated leucocytes, which have not undergone disintegration. The clot thus formed then contracts, serum is squeezed out, and the remaining firmer clot forms 'inflammatory exudation' or 'lymph.' We have then as the result of the third stage of the inflammatory process the spaces of the tissue of the inflamed area choked with

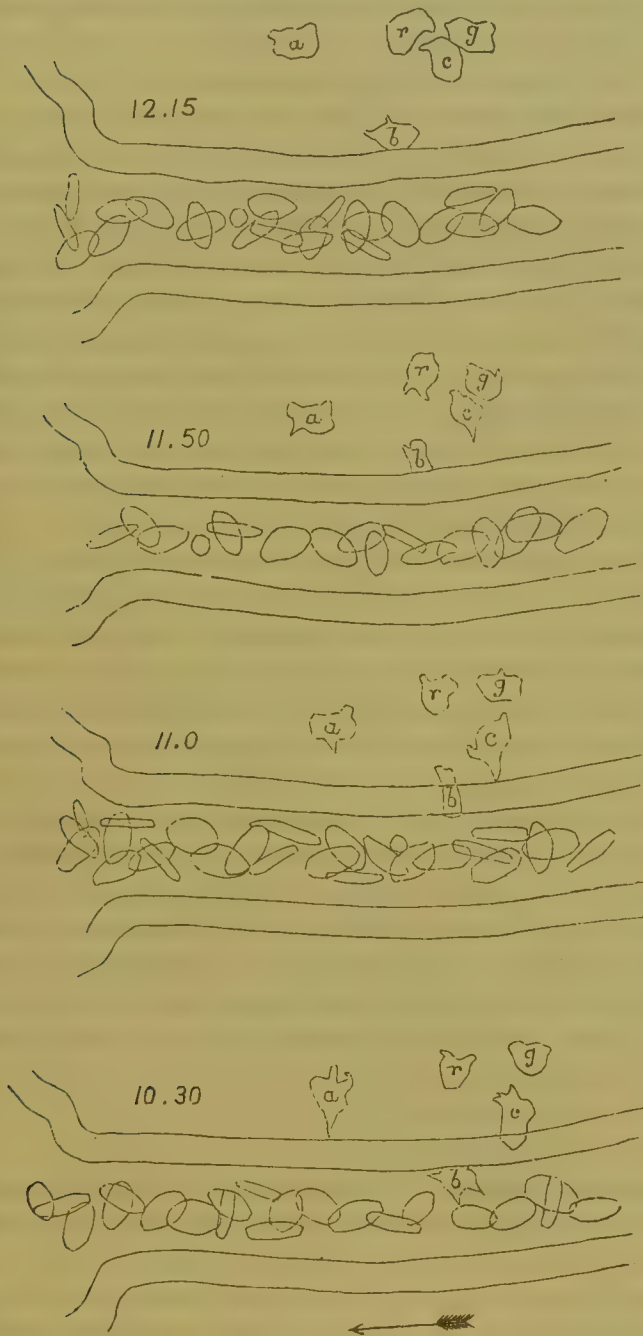


FIG. 1. Cohnheim's experiment showing the emigration of the leucocytes out of a vein in the mesentery of a frog. The times of the successive observations are marked on each figure, and the individual leucocytes are distinguished by different letters. *r* and *g* denote two leucocytes which were external to the vein at the commencement of the observation. *a* was only just attached to the outside of the wall of the vein at the commencement, and was free from it at the second observation. *c* had almost passed through the wall at the first observation, was only just attached at the second, and was free at the third. *b* had commenced to adhere to the interior of the wall of the vein at the commencement, had partially penetrated it at the second, was adhering to its outer wall at the third, and was becoming pedunculated and preparing to detach itself at the fourth.—From an experiment made for me by my friend and pupil, the late Mr. J. R. W. Webb.

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'lymph' consisting of emigrated leucocytes, with a varying proportion of red corpuscles, held together in the meshes of the coagulated fluid constituents of the blood. Around this inflammatory lymph, which is confined to the inflamed area, the lymph spaces will be distended with the serum which has been squeezed from the clot in its contraction, and there will be a greater or less degree of œdema of the tissues in the neighbourhood.

So far the changes observed refer wholly to the vessels and their contents. But that the tissues around the vessels have an independent and most important part in the process cannot be doubted. Professor Lister¹ has observed changes going on in the pigment cells lying in the inter-vascular spaces of the frog's web, which testify to an action entirely independent of that in the blood or the vessels; and the action of irritants on the non-vascular tissues, such as the cartilages, will be found illustrated in subsequent pages. Again, as the blood stream becomes retarded, the blood begins to oscillate backwards and forwards in the vessels, and finally stops. This inflammatory stasis can be produced even when the vessels have been entirely emptied of blood and filled with milk in place of blood. It cannot therefore entirely depend upon, though it must doubtless be influenced by, the qualities of the blood. Nor can we imagine that the mere vascular wall can be the sole cause of so remarkable a phenomenon. It must therefore be caused in some measure by the vital actions which are going on in the part generally. And the same conclusion results from many of the other recorded facts, for which I must refer to works of more detail. The latest researches seem to show that irritants which do not affect the walls of the vessels, though they may cause dilatation of the capillaries and stagnation of the blood current, are not followed by emigration of leucocytes, or by transudation of the coloured blood discs; while if an irritant be applied which acts so deeply and so continuously as to affect the wall of the vessel itself, an abundant emigration of colourless and coloured blood-discs ensues. The question therefore above alluded to would be answered by saying that the essential phenomena of inflammation depend on changes in all the structures—the blood, the blood-vessels, and the parenchyma of the part simultaneously. The changes in the latter, as we shall hereafter see, consisting in a degeneration of the original tissues.

Thus far then in the process of inflammation we have got an inflamed area infiltrated with inflammatory lymph. We have seen how the vessels have become dilated: how stasis has occurred: how exudation of liquor sanguinis and corpuscles has taken place, and how this effused material has coagulated in the tissues. Up to this time the original structure of the tissue in the inflamed and infiltrated area has remained unchanged, and supposing the irritation which caused the inflammation to be slight and temporary, the part recovers itself. 'Resolution' is said to take place. This simply means a return to a natural condition of health. Diapedesis ceases; corpuscles flow on; liquid exudation drains away, and migrated corpuscles are broken up and absorbed, and find their way into the circulation through the lymphatics. The part is thus restored to its pristine condition, and no trace remains to mark the process which has been going on. Should however the damage be greater, or the irritant which caused the inflammation be more persistent, migration goes on until leucocytes become heaped up in the inflamed area to such an extent as to press upon the original tissues of the part, and degenerative changes occur in these tissues which result in

¹ 'Phil. Trans.' 1858, p. 678.

their disappearance, and their replacement by a new tissue, which is called 'granulation tissue.' So that in the inflamed area we can discover now no trace of the original structure of the part, but simply a mass of round cells embedded in an apparently homogeneous matrix, and in which elementary blood-vessels soon appear. This is granulation tissue, and it is so called because it resembles in structure the granulations seen on the surface of a wound. The origin of this tissue is still to a certain extent a matter of doubt. Some authors have believed that the round cells of granulation tissue are simply the emigrated leucocytes of the blood, or these same bodies after they have undergone repeated division and subdivision, and there seems to be little room to doubt that this, at all events, is *one* source of these round cells; but that it is the *only* one would appear to be a very doubtful point. If, for instance, we irritate some non-vascular structure—say, a piece of cartilage—we shall find that the same result will be obtained as in the case of an irritant applied to a vascular tissue; that is to say, a replacement of the natural tissue of the part by granulation tissue. Clearly in this case the round cells of the granulation tissue cannot be proliferated leucocytes, for there are no vessels in the structure from which these bodies can have emigrated. And if we watch the result of the application of an irritant in this non-vascular part closely, we shall see that the cartilage cells proliferate. The nucleus divides, and around each nucleus a mass of protoplasm collects, so as to form two cells within the capsule. As however the process becomes more intense, the division of the nuclei becomes so rapid that they cease to collect protoplasm around them. At the same time the capsules dilate, and pressing on the intercellular substance cause it to disappear, so that soon the injured area of cartilage consists of simply the original capsules much dilated and filled with round cells, derived from the proliferated cartilage cells and resembling leucocytes. Then the capsules open into each other and on to the surface; embryonic vessels begin to appear, and we have a true granulation tissue formed, in which the cells, without doubt, have been derived from the normal cells of the original tissue, and not in any degree from leucocytes. The same process has been observed to take place in vascular tissues, where the connective tissue cells have been seen to multiply.

We are therefore in a position to state that the source of the round cells of granulation tissue is two-fold; being partly derived from the white corpuscles of the blood which have emigrated through the walls of the vessels, and partly from proliferation of the connective tissue cells of the part.

The subsequent changes which this granulation tissue undergoes will be considered later on in considering the results of inflammation. It will be most convenient, I think, to leave the consideration of the rest of the pathology of inflammation until we have considered its causes, symptoms, and treatment.

As in every injury there are two factors present which determine the effect produced by the injury, namely, the force and nature of the body inflicting the injury, and the resistance of the tissue to which the injury is applied, so in inflammation there are two sets of causes which will have to be considered in connection with the etiology of this affection. First, the causes which excite or produce the inflammation, and which are known as exciting causes or irritants, and secondly causes which lessen the powers of resistance of the tissues to the effects of those irritants, and which are classed as the predisposing causes.

Causes of
inflammation.

The chief exciting causes of inflammation are : 1. Mechanical injuries, Exciting
causes.

such as contusions, wounds, friction, pressure from foreign bodies either from without or from within, as accumulation of fluid in a joint. 2. Injuries produced by the application of heat, cold, or electricity; the latter producing inflammation only when it has given rise to decomposition of the tissues. 3. Chemical injuries, such as caustics; animal products (cantharides, stings of insects); vegetable products (croton oil). 4. Causes acting through the nerves, such as the reflex irritation which produces conjunctivitis in one eye as the effect of over-working the other at the microscope (Paget). 5. The chemical products of putrefaction, and 6. Organised irritants. These two latter are by far the most important causes of inflammation, and require a more special consideration.

Putrefac-
tion.

Putrefaction is now regarded almost universally as a fermentative process resulting in the formation of an alkaloidal substance, named *sepsin*, which when present in the tissues is a most potent cause of inflammation, leading to that prolongation of the inflammatory process which results in suppuration. For this fermentative process two things are necessary: the presence of *dead* animal matter, which is to undergo the process of putrefaction or fermentation—for this process cannot take place in living tissues, which have in themselves the power of resisting putrefaction; and, secondly, the presence of a ferment.

In addition to this certain accessories are also necessary; as the presence of water, oxygen, and the maintenance of a certain temperature; but, of course, these conditions are always present in the living body. The dead animal matter is principally the serum of the blood which is expressed out of blood clots. If blood be drawn from the body and allowed to stand, it speedily congeals into a jelly-like mass. This speedily begins to contract and squeeze out the contained serum, so that the mass is soon separated into two parts, the crassamentum or clot, and a yellowish fluid, in which it floats, the serum. Exactly the same thing takes place in the living body, when any blood has been poured out of its natural habitat, the vessels, as the result of an injury or otherwise. It speedily congeals and then separates into clot and serum, and this fluid, if not removed from the body, being a highly putrescible material, rapidly undergoes putrefaction when brought into contact with a ferment.

The ferment of putrefaction is usually believed to be a vegetable micro-organism named the *Bacterium termo*, a definite genus in the class Schizomycetes. It is a rod-shaped or oval body, its length, as a rule, being never more than twice its breadth. It multiplies itself by fission, and arises solely from pre-existing organisms. It is admitted directly from without, either from the air, in which it is found in varying numbers, or from water, which would appear to be the favourite habitat of this organism. It is never admitted by the lungs or alimentary canal, for in the presence of living tissues it perishes, and it can only be cultivated and multiplied in the presence of dead organic matter.

Organised
irritants.

The organised irritants which may cause inflammation are of two kinds: animal and vegetable. The animal organised irritants are of little moment, and are such organisms as the *acarus scabiei* or itch-insect, or the *pulex penetrans* or sand-flea. The vegetable organised irritants are, on the other hand, of the greatest importance, and are now supposed to be the direct cause of many infective forms of inflammation. These micro-organisms, like the bacterium alluded to above, belong to the class Schizomycetes, but differ from them in many important particulars. The bacillus and the micrococcus

constitute the most important organisms of this class of an infective nature. The bacillus is a rod-shaped organism, generally several times longer than it is broad. It multiplies in two ways, either, like the bacterium, by *fission*, that is by simple longitudinal extension and then division into two segments, or by *spore formation*, the parent sending out a long filamentous process (leptothrix) in which may be seen bright spots which soon develop into spores. The filament then ruptures and liberates the spores, which rapidly develop into fresh rods. It differs therefore from the bacterium in its greater length in relation to its breadth, and in its power of multiplication by spores. The micrococcus is a round or oval organism which occurs in pairs, or colonies (zooglæa), or chains. This mode of arrangement is due to its manner of multiplication, viz. by fission, which sometimes results in its being grouped in fours or more, as in the Sarcinæ, or sometimes arranged in chains numbering several hundreds. These organisms differ very materially in their behaviour in the body from the bacterium above described, which perishes in contact with living tissue, and like the vulture feeds only on dead matter. These organisms have the power of self-multiplication and growth in the living tissues, and when introduced into the circulation by the lymph stream or by the blood-vessels, increase with enormous rapidity and cause a true infection, both locally in the part where they were first introduced, and also generally in the system.

Predisposing causes of inflammation are those which lessen the powers of resistance of the tissues to the effects of injury, and among these must be classed those vitiated conditions of the blood which result from habitual intemperance, want of proper food, or disease of the eliminatory organs, especially Bright's disease, or diabetes, or disease of the liver. Under these conditions the vitality of the tissues is much diminished, and a lower degree of injury is required to produce inflammation. Moreover, it is an undoubted fact that the healthy living body is able to fence itself against the permeation of the blood and tissues by those organised irritants which we have seen are amongst the most potent existing causes of inflammation, unless these bodies are introduced in very large quantities. But where the vital powers are depressed, the entrance of these organisms is permitted, and thus this condition predisposes to inflammation by allowing the entrance of these living exciters into the system. This has been abundantly proved by the investigations of Mr. Cheyne, who found that in healthy animals who resisted the entrance of micrococci he was able to bring about their introduction by lowering the system of the animal by the administration of phosphorus. Certain specific conditions of the system, such as gout, rheumatism, syphilis, and scrofula, must be regarded as predisposing causes of inflammation, since they tend to favour its occurrence from very slight irritation. Lastly, imperfect vitality of a part, such as that which is produced by altered or weakened nerve power, or by passive congestion due to varicose veins, renders the part peculiarly liable to inflammation, and must be ranked amongst its predisposing causes.

Predisposing causes.

The four great cardinal signs of inflammation, as enunciated by Celsus, are 'pain, heat, redness, and swelling,' and to these may possibly, with advantage, be added a fifth, viz., modification of the function of a part. The pain of inflammation varies very considerably. Even in inflammation of the largest and the most vital organs there may be little or no pain, while in some of the smallest (such as the fingers) the pain may be intolerable. Much depends on the extensibility of the inflamed part; thus the acute pain

Local signs of inflammation.

Inflammatory pain.

in whitlow and in orchitis is explained by the resistance offered to the increase of the swelling by the sheath of the tendon, and by the tunica albuginea respectively. Still more depends on the peculiar sensibility of the organ. The physical cause of pain it is often impossible to ascertain. Pain is often greater in diseases when there is no evidence of inflammation (as in neuralgia) than when inflammation is not only dangerous, but even fatal (as in gangrene of the lung); and most severe pain may be experienced, as every one knows, in conditions of the body which are compatible with perfect health. Yet this does not destroy the great importance of pain as a symptom of disease in general and inflammation in particular. It only shows that in clinical investigations it is necessary to take account of all the circumstances of the case—not of one only. The persistence of pain in any given part ought to induce the surgeon to examine closely the condition of the general system (pulse, tongue, temperature, and secretions) and of the part itself, (as to redness, swelling, heat, and the functions of the organ), and on such an examination a secure diagnosis can almost always be founded. The pain of inflammation would appear to be due mainly to the pressure of the exudation on the terminal filaments of the sensory nerves, or from exudation taking place within the nerve sheaths and pressing directly on the nerve fibres themselves. It possesses this important characteristic, that it is always increased by pressure, which circumstance affords an important diagnostic sign in the differentiation of inflammatory pain from that arising from other causes, as, for instance, from neuralgia, which is often relieved, instead of being increased, by pressure. The character of the pain varies somewhat with the character or nature of the tissue or organ inflamed. Thus the characteristic pain of inflammation of a serous membrane is of a stabbing or lancinating character; the pain of an inflamed mucous membrane is described as burning; in ostitis the pain is usually gnawing or aching, and is worse at night; in inflammations of the testicle or kidney it is sickening, while the characteristic throbbing pain of suppuration is often a useful sign in coming to a determination as to the presence of pus.

Inflam-
matory heat.

The temperature of an inflamed part is raised above the normal. The patient is generally sensible of this from his own sensations, and it is familiar to everybody from his own experience. The increase in heat may be always proved by the thermometer, and it is evidently caused, at all events to some extent, by the mere loading of the part with blood. But some have maintained that not only is the part more richly supplied with blood at the usual temperature of healthy blood, but that heat is generated in the inflamed part, and thus the temperature of the blood at the focus of inflammation is raised above that of the rest of the blood, and, therefore, that the blood leaving the inflamed area is hotter than that entering it. John Hunter taught the reverse of this doctrine.¹ He quotes some experiments to prove that the temperature of an inflamed part never rises above that of the blood in the heart. Subsequently, Mr. Simon and others maintained the opposite view, and placed on record a series of experiments, whereby they believed that they proved that there was a development of heat in the inflamed part itself. Most recent observations with a thermo-electrical apparatus have tended to show that the increase in temperature in the part is the same as that throughout the blood generally, and that even if heat is developed locally in an inflamed part, it is so slight that it can have no appreciable effect on the general rise of temperature in the body.

¹ See Hunter's works, by Palmer, vol. iii. pp. 338, 340.

The redness of inflammation depends on the loading of the inflamed part with blood, and the accumulation in the blood-vessels of the coloured corpuscles. On viewing the change in colour in an inflamed area attentively, it will be seen that the colour varies at different parts, and under different circumstances. At the marginal part of the inflamed area the redness will usually be found to be of a bright, scarlet hue, and here it will disappear on pressure, denoting a condition of simple dilatation of the blood-vessels, and an increased flow of blood, or, in other words, the first stage of inflammation. Towards the centre of the inflamed area, on the other hand, the redness will be of a darker or more dusky hue, and will persist on pressure, denoting that here stasis has taken place, or that the second stage of inflammation has been reached. So, again, in some inflammations the hue is much brighter and more vivid than in others, indicating in the former that the circulation through the vessels is free and active, and in the latter that there is a tendency to stagnation, it may be, from an enfeebled condition of the patient's circulation. It must be borne in mind, however, that this condition of *redness* is by no means a constant sign of inflammation. Some tissues, when inflamed, present other alterations in colour. The iris, for instance, when inflamed becomes of a greyish or greenish hue, and the mucous membrane of the bladder of a peculiar slate-coloured tint.

Inflam-
matory red-
ness.

The increased supply of blood in the part must necessarily, to a certain extent, cause *swelling*; but another, and the main cause of the swelling, is the exudation which takes place into the peri-vascular tissues of the inflamed part, as the impediment to the blood-flow increases. We have seen that in the third stage of inflammation an emigration of the leucocytes and, to a less extent, of the red corpuscles of the blood, with transudation of serum takes place, and it is to the collection of effusion in the parenchymatous tissue that the swelling of inflammation is principally to be attributed. It will be obvious, therefore, that it must vary very greatly according to the tissue inflamed. In soft, lax textures, like connective tissue, the swelling will be very great, while in dense hard structures, as ligament and bone, the increase in size can be very slight.

Inflam-
matory swell-
ing.

The function of a part is always modified in inflammation, and this modification is always of a degenerated or lowered type. Thus the use of a part is interfered with, the bladder cannot bear the presence of urine, the eye cannot bear light, a joint cannot bear movement, or an inflamed muscle cannot bear contraction. Or again, the secretion of a gland is modified, it either ceases to secrete, or pours out a vicious secretion entirely different from its healthy, normal character, and thus the functional activity of organs or tissues is perverted or abolished by the inflammatory process.

Inflam-
matory modi-
fication of
function.

Inflammation, when extensive or very violent, is accompanied by general fever, which is designated 'inflammatory' or 'symptomatic' fever, and the leading symptom of which is a rise of temperature of the whole body. The question naturally arises how this increased general production of heat is brought about. By some it has been attributed to the local production of heat in the inflamed area. But, as we have above shown, it is extremely doubtful whether there is any development of heat in an inflamed part, and even if there were, it could only have a very minor share in the increased temperature of the whole mass of the blood, for the amount of heat generated in the inflamed area—so slight that it requires a delicate thermo-electric apparatus to prove its existence—could clearly have very little influence in elevating the temperature of the whole body. The rise in temperature has

Inflam-
matory fever.

been attributed to the introduction into the blood of some noxious material, derived from the changes which are going on in the inflamed tissues. It will be shown hereafter, in speaking of septicæmia, that the febrile condition in these cases is due to the introduction into the blood stream of the chemical products of decomposition, and if this produces fever in the one case, why should not some other *materies morbi*, if such can be proved to be present, produce the fever in another? Of course, in the inflammatory fever under consideration it is understood that there is no putrefactive change going on, and therefore the fever is different from septicæmia, since there are none of the products of decomposition to produce it. It has been shown by Edelberg, Köhler, and others that the injection of the so-called 'fibrin ferment' into the blood of living animals, in small doses, produces a rise of temperature and other symptoms of fever, somewhat resembling those of septicæmia, and that in large doses it produces death from rapid clotting of the blood. It is known that this fibrin ferment is given off during the disintegration of leucocytes, and that large quantities of these bodies are disintegrated during coagulation. It is argued therefore that in a condition of inflammation, where the inflammatory exudation coagulates, leucocytes are disintegrated, setting free the fibrin ferment which, circulating in the blood stream, acts as a noxious influence and generates the fever. Again, and lastly, the nervous system has been credited with an important share in the production of the fever. Physiologists believe that there is, situated in the medulla oblongata, a heat-regulating centre, whose office it is to maintain the heat of the body at a regular and constant level. This centre it is believed may be thrown out of gear by the inflammation going on in some distant part of the body; some thinking that this is due to the vitiated blood from the inflamed part flowing through the heat-regulating centre; others believing that it is a reflex act, due to tension on the peripheral terminations of the sensory nerves of the inflamed area.

Symptoms.

A good opportunity of watching the phenomena of traumatic fever is furnished by any great operation, such as an amputation, undertaken for the removal of a chronic disease on a person previously in good general health. The state of the pulse, tongue, and secretions, and the normal temperature should be carefully noted for the two or three days preceding the operation; and morning and evening observations should be regularly taken after it until the temperature and all other matters observed have returned to a condition of health. The fever usually commences within twenty-four hours of the receipt of the injury, but may sometimes date almost from the moment of its receipt. What is generally observed, however, is that at the first registration of the temperature, say, on the evening of the injury, the thermometer indicates a degree of heat below the normal temperature of the blood. This subnormal condition of the temperature is due to the shock of the injury or operation, as the case may be. On the following morning the thermometer will register a normal, or it may be a temperature slightly above normal, and from this time it will continue to rise until it reaches its fastigium or greatest intensity. The patient feels hot and uncomfortable, with occasional intervals of chilliness, sometimes amounting to definite rigor. He is thirsty and restless, with a rapid and perhaps hard and bounding pulse, furred tongue, hot and dry skin, scanty and high-coloured urine, constipated bowels, flushed face, headache, and loss of appetite. The symptoms are aggravated towards night, when a definite rise of temperature can usually be noted. In uncomplicated cases of inflammatory fever the symptoms will probably begin to decline from

about the second day after its commencement, and will have entirely subsided by the fifth, sixth, or seventh day; but there is much variety both as to the period at which it attains its climax and as to its total duration. The first appearance of decrease is very often coincident with the occurrence of suppuration. After the subsidence of the primary attack of fever, a secondary attack sometimes occurs, apart from any other complication, but usually the reappearance of fever denotes the occurrence of some of the complications of wounds, as deep-seated abscess, erysipelas, phagedæna, or pyæmia. When the fever does not subside at the ordinary time the presence of some concealed source of irritation, such as lodged foreign body or obstructed discharge, is probable and should be carefully sought for.

The treatment of inflammation is best studied in each individual form of it. The old idea is now given up, that inflammation is an excess of vital action which must be combated by reducing the powers of life, i.e. by bleeding, purging, and starving, the main elements of what was called the 'antiphlogistic regimen.' Surgeons, and still more physicians, have had only too good reason to recognise the fact that this treatment is the more fatal the more dangerous and deadly the inflammation itself is, that many of the worst forms of fevers and many of the most formidable results of injury require for their successful treatment not depletion, but support and stimulation. It is quite possible that in the reaction from the errors of a former time we have carried the regimen of support and stimulation to an excess. And it is easy in practice to forget what is so obvious in theory, that the support afforded by tonic medicines, foods and stimulants, depends not on the quantity given, but on that which is assimilated.

Treatment
of inflam-
mation.

In considering the treatment of acute inflammation in this place, we shall speak only of those cases of inflammation occurring without evident wound, leaving the consideration of the treatment of inflammation consequent on wounds until we come to speak of those injuries. In these cases, as regards the local treatment, the first and most important indication is to protect the tissues from all sources of irritation, and here rest is of the highest importance. The inflamed part must be kept as perfectly quiet as possible, all use of it interdicted, all movement of it prevented. In the furtherance of this end the surgeon must be guided by the particular case under observation. If a joint for instance is inflamed, he must give rest to the limb and prevent movement of the articulation by a carefully adjusted splint: if an eye is inflamed, he must exclude the light so as to give physiological rest to the injured organ; and so with every part with which he has to deal he must consider how best he can fulfil this important desideratum of giving absolute and entire rest. Again, he may protect the injured part from irritation by the relief of tension. This is always present to a greater or less degree in inflammation, and may often be relieved by elevating the part and attention to position; occasionally, however, incisions may be required for its relief, but of these more particular mention will be made in another place. It need scarcely be said that irritation must be relieved by the removal of the cause of the inflammation, if this be possible. It is, however, principally in connection with inflammation arising from wounds, &c., that this is necessary, where the removal of any foreign body is an all-important adjunct in the treatment. Secondly, in the local treatment of inflammation, efforts must be made to diminish the vascular excitement, and this is to be effected by the application of cold, local depletion, position, and, as has been suggested by some, by ligature of the main artery of the limb.

Applica-
tion of
cold.

The use of cold as a remedy for inflammatory conditions is one of the most important at the command of the surgeon, and acts as a most powerful antiphlogistic agent. Its first and immediate effect is to deprive the part to which it is applied of more warmth than it would lose under ordinary circumstances. But at the same time this deprivation of warmth acts as a strong irritant and produces an energetic contraction of the muscular fibres of the blood-vessels and the skin. The part grows paler, because less blood circulates in the contracted vessels. If the application of the cold be continued for some time, the local changes in the tissues become diminished because the parts acquire, by degrees, so low a temperature, that chemical processes take place in them with increasing difficulty. The effect of the application of cold is, of course, more powerful in proportion as the inflamed part is nearer the surface of the body, but deeper seated parts are by no means inaccessible to its influence.

The chief means at our disposal for applying cold are by compresses, immersions, irrigation, by the application of cold water by means of Leiter's tubes, or by bags or bladders of ice. *Compresses* are by no means an efficient means of applying cold, and ought to be discarded for this purpose. For either, if they are not constantly changed, they very soon acquire the temperature of the inflamed part, or, if constantly changed, they produce an injurious irritation from the constant handling and interference with it. *Immersion*, by means of the local bath, is an admirable way of applying cold, but is only applicable to certain situations, that is to say to the forearm and hand and to the leg and foot, and even in these parts the limb has to be maintained in a somewhat dependent position, which interferes with the return of the venous blood, and therefore has a tendency to produce a condition of passive congestion. In general febrile conditions the immersion of the whole body in a cold or tepid bath has a wonderfully antiphlogistic action and a powerful effect on reducing the temperature. This subject, however, falls more under the domain of medicine than surgery. *Irrigation* is an exceedingly valuable mode of applying cold to an inflamed surface. Iced water, to which some antiseptic may be added, is placed in a Florence flask and suspended from the bed cradle, and a skein of lamp-wick cotton hanging out of the flask allows the fluid to drip over the diseased part, which may be covered with a single layer of lint to diffuse the water. By regulating the size of the wick the supply of fluid can be nicely regulated, and an arrangement of macintosh sheeting serves to carry away the overflow. This plan of applying cold possesses the advantage over the ice-bag, or Leiter's tubes, of not necessitating the application of any weighty substance to the inflamed and sensitive surface. The pressure of an ice-bag, or Leiter's tubes, is often complained of by the patient as very painful when applied to an inflamed and therefore acutely sensitive part.

Leiter's tubes form a very convenient method of applying cold. The apparatus consists of a tube of flexible metal bent into a coil of parallel tubes, so as to form a kind of pad, and the shape of this pad can be easily adapted to that of the part which is to be refrigerated. One end of the tube communicates with a basin of cold water placed beside the patient's bed, and cools the part effectually without producing any moisture and with the great advantage of maintaining a uniform temperature. Finally, heat may be abstracted from a part by the application of an india-rubber bag or bladder filled with ice or some freezing mixture. Of the two the india-rubber bag is much to be preferred to the animal bladder, since the latter is never

completely water tight and very soon becomes offensive. By means also of the india-rubber bag too great an amount of cold cannot be applied, since this material is a bad conductor; whereas animal bladder conducts heat much better, and therefore a greater amount of attention and care is required lest the application of too intense a degree of cold should cause a condition of gangrene.

Local depletion or blood-letting is one of the most efficient means which we possess of diminishing the vascular excitement of an inflamed part. This it does, partly by drawing away the blood directly from the engorged blood vessels, and partly by exciting a reflex action in the arteries leading to the inflamed part by drawing away the blood from the vessels in the neighbourhood, even though these vessels have no direct communication with those in the inflamed area. Blood may be abstracted locally either by leeches, scarification or cupping. Leeching is as a rule the most convenient method of employing local blood-letting. Each leech may be calculated to abstract about two drachms of blood, and subsequent fomentation may increase the amount to about half an ounce, so that a rough estimate of the quantity of blood drawn may be made from a calculation of the number of leeches employed. The part to which the leeches are to be applied should be first washed with a little milk and the leeches dried in a soft cloth. They may then be placed in a small tea or egg cup, which is to be inverted over the part. When applied to the inside of a cavity in the body, as the vagina or mouth, a 'leech glass' should be used, which should be retained in position until the leech relaxes its hold. As a rule there is no difficulty in checking the hæmorrhage from a leech bite, should it not cease spontaneously, by means of pressure. Occasionally in children the bleeding is troublesome, but may always be controlled by passing a fine needle across the base of the bite and tying a ligature tightly beneath it. *Scarifications and small punctures* are another means by which local blood-letting may be performed, and possess this advantage, that they relieve tension by giving exit to effused fluids, as well as by the abstraction of blood. The operation consists in making a number of small incisions, not more than a quarter of an inch in depth over the inflamed surface, with the point of a lancet. The proceeding is especially beneficial in conjunctival chemosis, in œdema of the glottis, and in acute tonsillitis in the early stage. A modification of the process may be adopted in cases of acute inflammation of the testicle, when the puncturing of one or two of the small veins of the scrotum often gives great relief. *Cupping* is merely the same operation as the one just described, only performed by a special apparatus, and in which the flow of blood is encouraged by partially exhausting the air in the receiver, which is applied at once to the skin. A partial vacuum is thus formed, and the blood extracted from the incisions fills it.¹ The proceeding is now very rarely employed, and indeed is not applicable to external inflammations on account of the pain and irritation which it occasions. In addition to this it leaves a number of indelible scars, and therefore cannot be practised on any exposed part of the body.

Local
depletion.

With the view of diminishing the amount of blood in an inflamed part, it has been proposed to tie the main artery of the limb or compress it in such a way as to arrest the flow of blood through it, without compressing its accompanying vein. The latter can only be done by digital compression, and is only applicable to certain positions where the artery leading to the inflamed part is within reach. Thus in acute inflammation of the knee joint, the

¹ The operation of cupping will be found described in the chapter on minor surgery.

femoral artery has been successfully tied, and it is said with beneficial results. The practice nevertheless is not one which is likely to be largely followed.

Constitutional
treatment
of inflammation.

In the constitutional treatment of inflammation the same indications are to be followed as in the local. That is to say, an endeavour must be made to protect the inflamed tissues from all sources of irritation, and secondly the surgeon must aim at diminishing the vascular excitement of the part. In all inflammations there is a condition of general unrest, and therefore the first indication in the treatment is to combat this condition by keeping the patient completely at rest, and removing from him, as far as possible, all sources of annoyance both bodily and mental; by maintaining a well regulated temperature and soothing the irritability of the nervous system by sedatives, such as morphia, the bromides, hyoscyamus, etc. At the same time the diet must be carefully regulated. If the inflammatory fever is of an acute and sthenic type, the diet must be low and restricted, but if on the other hand the fever shows a tendency to assume an asthenic type, the diet must be of a more nourishing, but easily assimilated, kind. The vascular excitement in the inflamed part is to be diminished by constitutional means; by lessening the quantity of blood in the body generally and by weakening the force of the heart's action by antiphlogistic remedies. Of these, general blood-letting by means of arteriotomy or venesection is undoubtedly the most powerful and efficient, and is probably not resorted to in the present day quite as often as it might be with benefit. In the reaction which has followed the 'bleeding days' of our ancestors, the pendulum may have swung too far in the opposite direction, and this remedy, which no one can deny is a most powerful one, be too much neglected. Still it must always be borne in mind, before rashly advocating this treatment, that blood once abstracted from the body can never be restored and is only very slowly renewed, and therefore it should never be removed unless the case appears imperatively to call for it.¹ Of other antiphlogistic remedies, aconite, antimony, and mercury are the three remedies which are most usually recommended. Aconite, in minim doses of the tincture every half hour, for eight or ten doses, produces a most marked effect upon the circulation in acute inflammatory fever, diminishing the frequency of the pulse and lowering the temperature to a very notable extent. Antimony, also, in small repeated doses, produces speedy and copious sweating, and has a very decided effect on the heart's action, and is useful in some forms of inflammation. Of the three remedies, mercury, perhaps, is the most efficient, and is the most extensively employed. It appears to possess especial power in preventing the effusion and promoting the absorption of inflammatory exudation. It is particularly useful in acute inflammations of serous and synovial membranes. Administered in small doses, it is often found to be of the greatest benefit in the treatment of these affections.

Lastly, purgatives, especially the saline purgatives, diuretics and diaphoretics, act as antiphlogistic remedies and are frequently of use in the treatment of acute inflammations by abstracting the watery constituents of the blood and diminishing the blood pressure generally.

Chronic inflammation.

In the previous pages we have been referring to the pathology, symptoms, and treatment of an acute attack of inflammation, but there is another variety termed chronic inflammation, in which, though the changes are the

¹ The operations of arteriotomy and venesection will be found described in the chapter on minor surgery.

same as in the acute, they take longer in their development and differ somewhat in their result. There is the same dilatation of the blood-vessels, the same stasis and the same migration of corpuscles and transudation of the watery elements of the blood, but these changes take place very much more slowly and to a very much less extent than in the acute form of inflammation. There is also, as in the acute, a destruction of the tissue of the part and its replacement by granulation tissue, but the subsequent changes which this new material undergoes differ somewhat from the changes which take place in it in acute inflammation, and lead to important results which will be hereafter more particularly referred to. The symptoms of chronic inflammation are the same as those of the acute, but are much less marked and some of them may be absent altogether. In fact this form of inflammation may be oftener recognised by the effect that it produces than by the local signs of the perverted action itself. Perhaps of the five signs of inflammation enumerated above, that of modification of function is the most constant symptom of chronic inflammation. The functional activity is almost always in some way or other interfered with or altered, the secretion of secreting structures is perverted, the movements of a joint are restricted, the ability of the bladder to retain water is lessened and so on, wherever we have a tissue or organ chronically inflamed, there we find that its function is not carried on as perfectly as in a condition of health. The pain of chronic inflammation varies, oftentimes there is little pain or tenderness, sometimes there is tenderness without pain, and sometimes there is even considerable pain, as in chronic inflammation of hard and unyielding structures such as bone and fibrous tissues. The heat of a chronically inflamed part is never very great, but there is always, I believe, some slight increase in the temperature, and this occasionally becomes an important diagnostic sign in this affection. In a chronic synovitis, for instance, there will be generally found to be a slight increase of heat on comparing the part with the joint of the opposite side, and this is often of use in diagnosing this condition from an hysterical joint, with which it is apt to be confounded. Redness is by no means a common sign of chronic inflammation, unless the part affected be very superficial, and when it is present it is generally of a dusky hue and is due rather to a passive congestion than to any increased vascularity of the part itself. Swelling is often present, but is here due to the effect of the inflammation and the formation of new products, and not to the enlargement of the blood vessels and increased quantity of blood, as in the acute form of the disease. In these cases there is no inflammatory fever, and any constitutional symptoms which may exist are due to the same causes which produced the inflammation, or are the result of secondary general conditions set up by the changes produced in the system by the chronic inflammation, as in the hectic fever produced by long-continued suppuration.

The treatment of chronic inflammation is a subject of considerable difficulty and can only be briefly alluded to in this place, and a few broad general rules laid down for the guidance of the surgeon. The reader must be referred to future pages for more precise directions for the treatment of these cases. It must be borne in mind that many of the cases of chronic inflammation which the surgeon will be called upon to treat depend upon some peculiar diathesis or unhealthy condition of the system, and therefore constitutional treatment with a view to correcting this condition is of paramount importance. Thus cod-liver oil, iron, and other tonics, are required in chronic inflammation of a scrofulous type : iodide of potassium and mercury where

it is due to a syphilitic taint. The dietetic and hygienic management of the patient is also of the most essential importance. Nourishing diet, of a light and easily digestible kind, and, if the disease assume an asthenic form, stimulants are indicated. The patient should be kept in pure air, and in many cases, especially those dependent on scrofula, sea air is most beneficial. The secretions must be kept free, and an occasional purgative will usually be found necessary and advantageous. As regards local treatment, our principal dependence must be placed on rest, counter irritation and pressure. Rest in the chronic, as in the acute, form of inflammation is of the first importance. This must be obtained by, if necessary, confining the patient to bed, or by restricting the movements of the part by splints or other surgical appliances. Its influence and application is too wide a subject to be entered into here, but the reader is referred to the very admirable lectures delivered by the late Mr. Hilton at the Royal College of Surgeons for a complete *résumé* of the subject.¹ Counter irritation, though cavilled at by some, is an effectual means of treating chronic inflammation. Its exact mode of action in arresting inflammation is at present unknown, but it is probably through the influence of the nervous system. The counter irritants employed in surgery may be classed as *rubefaciants*, such as the mustard poultice, which produces hyperæmia or active congestion of the portion of skin on which it is placed: *vesicants*, as blisters, which destroy the cuticle and cause an exudation beneath it, constituting a blister or bleb: and *pus producing* counter irritants, as the seton or issue.

Pressure is often an excellent means of treating chronic inflammation, and is especially useful in getting rid of its results in the form of effusion and in supporting feeble vessels where there is much passive congestion. It may be employed by bandages, strapping, elastic webbing, or by Martin's india-rubber bandages, which can be applied so as to make any amount of compression which may be required. To these principal means of treating chronic inflammation may be added friction and massage, dry cupping, local blood-letting, and sometimes incisions to relieve tension, all of which will be found useful adjuncts in treating some forms of this condition.

Results of
inflammation.

In the preceding pages we traced the course of an inflammation, through its stages of dilated blood-vessels and increased flow of blood, of stasis, and of emigration of corpuscles and transudation of serum, to a condition in which we found the parenchymatous tissue outside the vessels loaded with small round cells and inflammatory exudation, and we saw that, if the irritant which produced the inflammation was not very severe or long continued, this condition might be recovered from completely and no trace of the inflammatory process which had taken place be left behind; but that, if the irritant were more severe or more prolonged, coagulation of this exudation took place, which gradually destroyed and replaced the original tissue of the part and nothing remained but this new material, which became vascularised and to which the name of 'granulation tissue' was given. It now remains to consider what changes this new structure, which has replaced the original tissues of the part, may undergo. They are as follows:

First, the granulation tissue may undergo a process of organisation and be converted into a new structure of a less complex type than that of which the original tissue of the part consisted. This new structure is named cicatricial tissue and belongs to the connective tissue group. The process has been said by some authors to be one of 'Retgression,' and the name

¹ 'Lectures on Rest and Pain,' by Hilton.

seems to be one of peculiar applicability, as there is a retrogression or decline in excellence from the original structure to one of a less complex nature.

Secondly, the granulation tissue may undergo a process of degeneration and, from malnutrition, the round cells of which it is composed may become converted into pus corpuscles, and pus may be formed, which, if it occurs in a closed cavity, constitutes an *abscess*; if on the surface of the body, so that the pus has a free exit, is termed *ulceration*. Lastly, if the inflammatory process is very acute, the tissues inflamed die before they have been replaced by the granulation tissue, and with them perish also the round cells of this latter tissue. Under these circumstances we have as a result of inflammation a condition known as *mortification*. Retrogression or the production of new tissue may be regarded as the curative termination of inflammation. It is true that in many instances this newly-formed tissue impairs the functions of the part and constitutes in itself a kind of disease. Thus the utility of joints is destroyed by soft ankylosis, the result of inflammatory adhesions; or bands of adhesion are formed in the peritoneum which may fatally interfere with the movements of the intestines. But it is none the less true also that it is upon such reproductive properties that all the repair of wounds and fractures depends, and that the greater part of the practice of surgery is directed to the production and regulation of this reproductive process.

It will be most convenient, I think, to study here this curative termination of inflammation as it is seen in the soft parts; while the chapter on the union of fractures will contain a description of inflammatory organisation in the hard tissues. I therefore turn to the general subject of wounds and the process of their union, in order to illustrate the results of inflammation.

A forcible solution of continuity in the soft tissues of the body is called a wound; but, in ordinary language, the exposure of the injured part to the air is implied, and the action of some weapon is also understood. When the subcutaneous tissues are merely bruised, i.e. more or less lacerated without the skin being divided, the injury is called a 'Contusion.' In a contusion there is probably always some laceration of the fibres of the cellular tissue, the vessels are more or less ruptured, and blood is extravasated proportionally into the subcutaneous or parenchymatous tissue, or into any of the neighbouring cavities of the body. In very severe contusions, such as are produced by repeated injuries, the skin is very extensively separated from the subjacent fascia,¹ and is consequently liable to perish for want of blood-supply. Into this space blood is effused, which, showing through the skin, gives the familiar black-and-blue appearance of a bruise, the colour varying with the delicacy of the skin, the quantity of blood effused, and the structure of the part. Thus, in the eyelids, scrotum, and vulva a bruise is black; on the scalp, where the skin is strengthened by the tendon of the occipito-frontalis, it shows hardly any colour at all; on the globe of the eye, where the conjunctiva allows the free passage of the air, it is scarlet. The black colour of an ordinary bruise on the surface of the body fades away into green or yellow as the blood is absorbed. Very frequently, when the laceration has been great, the blood remains for an indefinite time collected in a cavity, the walls of which are formed of blood-clot and condensed tissues, while its contents consist of serum

Wounds
and contu-
sions.

¹ In examining the body of a schoolboy who had been beaten to death by his school-master, Sir Prescott Hewett and I found the skin so extensively separated from the fascia lata, that a common walking-stick could easily be laid between.

Hæma-
toma.

mixed with more or less of the colouring matter and broken-down corpuscles. To such a collection the name Hæmatoma, or 'blood-tumour,' is given. Blood-tumours are distinguished from abscess by the history, appearing as they do at once after the contusion; by the thinner character of the fluid, contained in a wall of solidified, but not inflamed, tissues; and by the uninflamed and unengorged condition of the integuments. They are comparatively common on the scalp in infancy and childhood, sometimes extending over half or the whole head. They usually subside spontaneously, even when of very large size, though their absorption is generally considered to be accelerated by some of the stimulating lotions or embrocations usually ordered, among which arnica is perhaps the most in favour.¹ But such stimulating applications should not be made use of immediately after the injury. The application of cold is indicated at first, so long as it seems probable that fresh blood is being effused; unless the skin is so extensively separated that gangrene is to be feared, in which case moderate warmth (as by water-dressing or warm opiate lotion) is more advisable. In some cases, when the effused blood shows no tendency to disappear, it has been removed by puncture with impunity; but as this is usually unnecessary, it should not be done except in the last resort, and then the 'aspirator' of Dieulafoy, or some such invention for avoiding the entrance of air, should be employed. If the tissue around inflames, forming pus, the bloody fluid becomes decomposed and a serious form of fever may be generated. In such a case, as in that of inflammation of the sac of an abscess, it becomes necessary to lay open the cavity freely, wash it out with carbolic lotion daily, and support the patient's strength through the ensuing fever.

The question as to the organisation of bloodclots is one of much interest, both in a pathological and practical point of view. John Hunter taught unreservedly that coagulated blood 'either forms vessels in itself, or vessels shoot out from the original surface of contact into it, forming an elongation of themselves, as we have reason to suppose they do in granulations;' and in order to define his meaning more precisely he immediately adds, 'I have reason, however, to believe that the coagulum has the power, under ordinary circumstances, to form vessels in and out of itself;' and of this supposition he proceeds to give proofs, for which I must refer the reader to the original.² On this supposed property of extravasated blood to take on active processes of organisation in its own substance, independent of the structures amongst which it was lying, depended, amongst many other surgical doctrines and precepts, the treatment so much recommended by Sir A. Cooper, and still occasionally practised, of laying a piece of lint steeped in the blood of the part over the wound of a compound fracture in order that the blood might form a bond of union, and convert the compound into a simple fracture. It seems, however, to say the least, highly dubious whether any such self-organisation of clots is possible. The practical result is doubtless the same, viz. that in the substance of the clot vessels are formed, and ultimately the coagulum is replaced by a membrane or fibrous sac more or less complete, and including in its substance the remains of the blood-corpuscles.

¹ The applications in common use in cases of contusion are:—Tincture of arnica, gently rubbed in, either pure or diluted with its own bulk of water, or as a lotion with five to ten parts of water; or poultices of black briony-root (much valued by pugilists); or Friar's balsam, or soap and opium liniment.

² 'On the Blood, Inflammation, and Gunshot Wounds.' Hunter's Works by Palmer, iii. 119.

But it seems more probable, as Rindfleisch has pointed out,¹ that the efficient agents in this organisation are leucocytes, which are derived, not from the white corpuscles of the clot itself, but by immigration from the neighbouring vessels or tissues. 'Artificial thrombi,' says this author, 'have been produced by tying arteries in the lower animals; cinnabar has then been injected into the blood, and its leucocytes impregnated with this finely granular material, which is easily recognisable under the microscope. It was found that those cells from which, on the second or third day after the occurrence of coagulation, the organising process appeared to set out, contained cinnabar—the inevitable inference being that they had emigrated into the clot from without.' He then describes the branching out and communication of the leucocytes to form 'a delicate protoplasmic network with nuclei in its nodal points,' through which capillary channels are afterwards opened out, these channels ultimately anastomosing with the vasa vasorum; while in the interspaces a connective tissue is formed from the fibrine of the clot, involving in its meshes the remains of the blood-corpuscles, which at first entirely obscure it; and then, as the clot shrinks and hardens, they wither away, lose their colouring matter, and there remains instead of every red corpuscle a flake of colourless protoplasm.

All this applies to the organisation of non-laminated thrombi contained within the vessels. Of the minute phenomena of organisation in extravascular and laminated coagula nothing is known. More will be found, on the changes which intravascular thrombi undergo, in the chapters treating of the diseases of the ARTERIES AND VEINS.

The treatment which is to be selected in any case of contusion depends on the severity of the injury. When the blow (as is often the case) entails much loss of power and pain in attempted movement, it is obvious that rest is the main requisite. Warmth should be applied, as by a piece of heated spongio-piline, or warm lotion, covered with oiled silk. In smaller and less disabling injuries some active movement is desirable, and gentle rubbing will relieve the pain and promote absorption of the effused blood.

Treatment
of contu-
sions.

Wounds, that is to say, *open wounds*, with division of the skin and therefore exposure to the air, are divided for purposes of description into *incised*—i.e. in which the length bears a considerable proportion to the depth, and the edges are clean cut; *contused*, in which the divided tissues and those around are contused as well as cut; *lacerated*, in which the whole or a portion of the solution of continuity is caused by tearing and not by cutting; and the *punctured*, in which the depth much exceeds the length, being more of the nature of a prick or a stab than a cut. To these possibly may be added another, the *subcutaneous* wound, in which a considerable extent of tissue (generally including one or more large tendons or muscles) is divided through a mere puncture of the skin. These are generally made by the surgeon and are obviously a kind of punctured wound. The symptoms of wounds are pain, bleeding and separation of the edges of the wound, and those symptoms vary, within certain limits, in the different varieties of wounds; in the incised wound the pain is usually of a smarting, burning character, while in the contused and lacerated wound it is of a dull aching character. The bleeding is much more profuse in the incised wound than in the lacerated one, because the vessels being torn rather than cut have less tendency to bleed, as will be shown when speaking on the subject of hæmor-

Wounds.

¹ 'Pathological Histology,' trans. for the New Syd. Soc., vol. i. p. 225.

rhage. In the punctured and subcutaneous wound the bleeding may be nil or next to nil, or may be very profuse if some large vessel has been wounded. In the incised wound the gaping of the edges is always greater than in the contused and lacerated wounds. In the former the wound being clean cut, all the tissues are fairly divided, and the natural contractility and elasticity of the part causes the edges to be drawn widely asunder. In the contused and lacerated wound on the other hand, where the edges are not cleanly divided, shreds of tissue serve to maintain the parts in apposition, and, moreover, the bruising of the tissues around to a certain extent destroys their properties of contractility and elasticity, and prevents the wide separation of the edges of the wound. As a rule in the punctured and subcutaneous wound there is no gaping of the edges.

Mode of
union of
wounds.

The processes by which wounds are united are usually described as being five in number. 1. Immediate union, primary adhesion, or direct growing together of opposed surfaces. 2. First intention, or union by coagulable lymph. 3. Scabbing. 4. Union by second intention. 5. Second adhesion or growing of two granulating surfaces together. But as a matter of fact, as I shall endeavour to show, there are but two modes by which union of wounds takes place, namely, with or without suppuration, and these five methods of union which have been mentioned are merely modifications of one or the other process.

Immediate
union.

1. When the surfaces of a clean-cut wound, such as that made in the operation for hare-lip, are carefully adapted to each other and supported for a sufficient length of time in apposition, they will probably be found to present no sign of inflammation appreciable by the senses, and in the course of from twenty-four to forty-eight hours the wound will be so soundly united as to require no further attention, nothing being left except a linear mark, which at first looks more or less red, but gradually fades away, and in the case of small cuts disappears altogether. This mode of union was first described by Macartney of Dublin as immediate union, or union 'without any intervening substance, such as blood or lymph,' or, in other words, union without inflammation. This, however, is hardly an intelligible account of the action of living tissues, and indeed, if we accept the definition of inflammation of Dr. Burdon Sanderson, that it is 'the aggregate of those results which manifest themselves in an injured part as the immediate consequences of the injurious action to which it has been exposed,' it is manifestly untrue. It is certain therefore that this process differs in no respect from that to be next described, except that the symptoms are less obvious.

Union by
first inten-
tion.

2. The second process is union by first intention; that is to say, union without suppuration, by 'adhesive inflammation' (Hunter). In order to study the process let us take a small wound in which no vessel of any magnitude is wounded.¹ The first change that occurs is that hæmorrhage is arrested, the bleeding ceases spontaneously from the formation of clots in the wounded vessels up to the first collateral branch. This is brought about by the contraction of the vessels from the stimulation caused by the injury, so that their orifices are partially or completely occluded, and by the exposure of the part to the air which acting on the blood has a tendency to cause it to coagulate. In the parts just beyond this area of coagulation, inflammation is set up, there is dilatation of the blood-vessels, so that the edges of the

¹ If large vessels are wounded hæmorrhage has to be arrested by artificial means, which complicates the description of the process. The subject of the artificial arrest of hæmorrhage will be discussed in the sequel.

wound present a blush of redness with slight swelling, and this is followed by stasis and inflammatory exudation. This effusion finds its way to the surface of the wound through the lymph spaces and there coagulates. So that if we could now view the surface of the wound we should find it covered with a layer of transparent material, which gives it a glazed or vitreous appearance. This is inflammatory exudation, or plastic exudation, the 'coagulable lymph' of John Hunter, and consists of coagulated fibrin holding in its meshes innumerable leucocytes, with a varying proportion of red corpuscles. This material then contracts and squeezes out of itself the serum, which drains away, and being possessed of a very considerable degree of adhesiveness causes the two surfaces of the wound to stick together, if they have been brought into apposition. This may be termed the temporary union, and serves to retain the edges of the wound in apposition until a more permanent healing has taken place by the vascularisation of this layer of plastic exudation and its conversion into cicatricial tissue. Before this is done, however, any shreds of tissue which have been so injured by the cut as to have had their vitality destroyed, and also any small clots of blood which may have been left between the edges of the wound, become embedded in the inflammatory exudation, and being subjected to the action of the living leucocytes of the effusion become absorbed and replaced by these bodies, without any suppuration taking place. The permanent process by which this inflammatory exudation is converted into a living tissue, which forms the bond of union, now commences. This consists in a budding out of pouches from the walls of the nearest capillaries, and these buds elongate into a loop and open into another part of the capillary tube, or else they meet with buds from the capillaries of the opposite side and join by absorption of their contiguous walls. From these, secondary buds are developed until the whole of the exudation is vascularised and converted into a layer of 'granulation tissue,' which is only another name for vascularised inflammatory exudation. This material then becomes converted into cicatricial tissue. The exact method by which this is accomplished is still uncertain. But, at all events, the cells of the tissue are known to elongate and become converted into spindle-shaped cells, which are arranged in lines, while the intercellular substance, which at first is scanty and homogeneous, becomes greatly increased in quantity and fibrillated; but whether, as is believed by some, the spindle-shaped cells become converted into fibre cells, and then into fibrous tissue; or whether, as is believed by others, this tissue is formed by fibrillation of the intercellular substance, is still uncertain. At all events a fibrous tissue is formed which constitutes the permanent bond of union or 'scar,' which is at first very vascular, but as time advances its vessels become obliterated to a very great extent, and it becomes much paler than surrounding structures.

3. The process of union of a wound by 'scabbing' may be best studied in a small wound, with loss of substance, i.e. when a small piece has been shaved off the surface of the body. On such a wound, if it be at once covered over and protected from exposure to the air, the blood, being retained in the rag or lint by which it has been covered, coagulates and forms a scab. The injured tissues inflame, and a fibrinous exudation is poured out over the surface of the wound beneath this scab; this coagulates, becomes vascularised by the budding up into it of the vessels beneath, and then becomes converted into fibrous tissue. As the inflammation subsides the scab, which has now become quite dry, begins to break away or separate at the margin, and as it does so epithelium is formed, growing inwards from the epithelial scales

Union by
scabbing-

of the surrounding skin, so that before it is completely detached a new layer of epithelium covers the surface of the wound. It will be seen, therefore, that the process of union by scabbing is identical with that of union by first intention, and that the scab merely acts as a protective covering to the wound, preventing decomposition or putrefaction.

It is obvious that the three modes of union above described are merely modifications of one process, and are identical in the pathological changes that take place. They may therefore with propriety be classed together under one head, as a mode of union without suppuration.

Union by
second in-
tention.

4. In union by second intention, or as it is sometimes called 'union by granulation,' the process in its essential features is identical with that which has already been described, and the difference between the two is one rather of degree than of kind. Taking, in the first instance, an incised wound, in which owing to some accidental circumstance the inflammatory process is prolonged and does not cease after a small amount of inflammatory exudation has taken place, as it did in the case of the wound uniting by first intention, we find that, firstly, the blood coagulates in the vessels up to the first collateral branch, so that the bleeding is stayed. Then there is hyperæmia and exudation. But this exudation, instead of being slight in amount, continues until the surface of the wound becomes covered with a very considerable layer, too copious to be retained in the interstices of the wound. The superficial cells contained in this thick layer probably from malnutrition from being removed so far from any source of nutritive supply, begin to degenerate and die and to be thrown off as pus cells. But while the superficial cells have been undergoing this process of pus formation, other changes are taking place in the layers beneath. If the surface of the sore be attentively watched, little red points will be seen here and there; these coalesce and extend over the whole surface, which becomes covered with a layer of red projections, called 'granulations.' These are formed by the budding up into the inflammatory exudation of buds or loops of vessels from those in the tissue beneath. So that we have now the surface of the wound covered with a layer of granulations; that is to say, little pyramids or heaps of cells, containing a vascular loop and being simply vascularised lymph. The granulations continue to grow until they fill up the wound and reach the level of the surrounding structures. Finally the granulations undergo cicatrisation and are converted into fibrous tissue. The upper cells of the granulations undergo a process of degeneration, and are converted into pus cells—so that so long as granulations persist there is an exudation of pus from the wound—and the lower cells become spindle-shaped, and fibrous tissue is formed either by the direct conversion of these cells into fibrous tissue, or by a process of fibrillation of the intercellular substance, exactly in the same manner as in the cicatrisation of the granulation tissue in union by first intention. The final stage of the process consists in the covering over of the surface of the newly formed fibrous tissue by a layer of epithelium, which is formed by a process of multiplication of the epithelial scales at the margin of the sore.

In the case of contused and lacerated wounds, which always unite by second intention, the process of union above described is preceded by another, namely that of separation of sloughs. In these wounds portions of tissue are killed outright and their vitality destroyed by the injury; and before the process of repair can take place these dead parts have to be separated from the living tissues and thrown off. This is brought about by the vital power inherent in the cells of the granulation tissue, whereby they absorb and

replace the cells of the tissue in contact with the dead parts, and then themselves perishing and becoming converted into pus, separate the dead from the living parts. The process is identically the same in the separation of these small pieces of dead tissue as it is in the separation of a limb after gangrene has taken place.

5. Besides the common process of repair by suppuration, i.e. union by granulation, or by second intention, there is another process described by Paget analogous to and in fact to a great extent identical with it essentially, but differing in some important practical details; this is union by *secondary adhesion*, or by the *third intention*. Union by 'secondary adhesion,' or by 'the third intention.'

It is best illustrated by the wound of an operation for harelip in which the attempt to obtain primary union has failed, and the surfaces of the wound have begun to granulate. If the ordinary process of union by second intention were allowed to go on to its termination, these granulations would gradually fill the wound up until the whole cavity was closed more or less imperfectly by a dense cicatrix; or, as would most likely be the case in the instance supposed, the two surfaces of the lip would scar over, and the fissure would not be filled at all. But sometimes, when the granulations are perfectly healthy, if the surfaces be brought evenly together throughout, they will adhere without any further suppuration, the growing tissue at the base of one set of granulations coalescing with that at the base of those on the opposite side, and thus the wound will be closed perfectly and at once.

The advantages of this process are that it leaves much less scar behind; that the scar is much more nearly equal in size to the cavity which it fills, and that it is completed in a very short space of time, so that any bone or other important part which has been exposed in the wound gets rapidly covered over and defended from the inflammatory action. The two former points are of interest in wounds of the face or other exposed part; the last is of great importance in scalp wounds, where exposed bone can often be rapidly covered by bringing the granulating edges (if perfectly healthy) into contact by means of one or two silver sutures, and thus all risk of necrosis or inflammation of the exposed cranium will be avoided.

The material by which a wound is united is called a cicatrix. It differs from the normal tissue which it has replaced in many important particulars. As Rindfleisch says: 'The cicatricial tissue is far from being a connective tissue of ideally high quality.' It is more dense than ordinary areolar tissue, and contains no yellow elastic tissue. It is smooth on the surface, and presents no papillæ. It is devoid of sweat glands, sebaceous glands, or hair follicles. It contains no lymph spaces or lymphatics, and nerve fibres are very few in number, or altogether wanting. When first formed it is very vascular, but it exhibits an extreme proneness to contract in all its dimensions, and as it contracts the vessels become obliterated, and the scar becomes dry, compact, hard, and white, and contains but few blood-vessels. Cicatrices.

We have spoken incidentally of fever as one of the occasional phenomena of inflammation, but the subject of traumatic fever or 'wound' fever, as applied to the febrile disturbance following a wound or other injury, is so important in practical surgery that it demands a very careful study. The pathology of traumatic fever is still to a certain extent a matter of conjecture and doubt, but recent investigations and observations would appear to tend to prove that it is due to the absorption of some toxic products from the wound, and it would seem probable that the primary fever which follows bruises, wounds, fractures and such like, is due to the absorption into the Traumatic fever.

system of undecomposed serum, rendered 'pyrogenous,' or capable of producing fever, by the action of the fibrin ferment, which is set free by the disintegration of the leucocytes which have been shed from the blood-vessels, and this entirely without being complicated by any external septic influence. (See p. 14.)

Traumatic fever presents itself under two different forms: as *primary* and *secondary*, the one frequently occurring without the other. Thus we may, and frequently do, have primary traumatic fever without any secondary fever, and we may occasionally have secondary fever without any manifestation of the primary fever. The two may be separated by a distinct absence of fever, or the one may merge into the other without any remission of temperature. The primary traumatic fever does not necessarily follow every wound or injury. In 1868, before the days of antiseptic surgery, I recorded a considerable number of observations on the subject of traumatic fever, and in 108 cases of recent wound, I found that there were thirty-five in which there was a total absence of all symptoms of a febrile nature.¹ No doubt if a similar observation were made in the present day, the number would be found to be very much larger. The attack usually comes on about the second or third day, though in some rare cases it may be delayed to the fourth or fifth day. Any febrile condition occurring after the fifth day must be regarded as secondary traumatic fever in which the primary attack has not been present or has escaped notice. The symptoms of this primary fever may be thus briefly summarised. There is increased temperature at the seat of the wound and increase in the heat of the whole body, as proved by the thermometer, with chilliness and perhaps (but not usually) rigors as the heat rises; quick, sharp pulse; furred tongue; more or less sleeplessness, and the sleep which is obtained, unrefreshing; the urine is high-coloured, and the amount of urea secreted is above the normal standard, and exceeds the quantity which could be furnished by the nitrogenous aliment; the bowels are often sluggish and the motions offensive. The fever lasts from two to seven days. The temperature rises rapidly and generally reaches its highest point on the second or third day, it then declines, for the most part gradually, and reaches the normal standard about the sixth or seventh day. (Fig. 2.)

Such is the course of an ordinary attack of primary traumatic fever, but there are two or three points in connection with it which require a passing consideration. And, first, the relation which the fever bears to the wound, in cases where there is an open wound. It will generally be found that the greatest intensity of the fever,

as denoted by the thermometer, precedes the occurrence of suppuration, and that with the formation of pus and its free discharge from the wound, the temperature falls. Secondly, the fever is modified by circumstances:—Where there has been great loss of blood, the fever is very great, and the temperature high; while in those cases where there has been a violent shock to the nervous system, the fever is ill-defined.

In some cases the primary fever, instead of being followed by convalescence, merges into a second attack, and this may occur after the complete subsidence of the primary fever or during its defervescence. This is often of

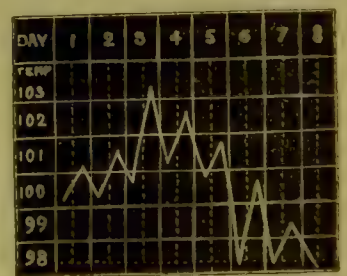


FIG. 2. Thermograph of Traumatic Fever.

Secondary
traumatic
fever.

¹ 'St. George's Hospital Reports,' vol. iii. 1868, p. 74.

the greatest significance, and denotes some important condition in the wound which must be sought for and removed, or some grave condition in the general state of the patient. It may be due to tension from pent-up discharge, or to the irritation of foreign bodies, or it may arise from some of those wound complications which will hereafter have to be described. It occurs generally from the sixth to the ninth day, and may subside rapidly if the cause which has produced it is speedily removed; in other cases it may pass into some of the specific inflammatory complications, such as erysipelas, phagedæna or pyæmia, or may even persist until it passes into hectic.

Beyond sedulous attention to the general state of the patient, cautious inspection of the part to see that no discharges are confined in the wound, and cleanly and skilful dressing, I know of no treatment for traumatic fever. It resolves itself mainly into the treatment of the injury from which the fever springs. Its prophylaxis is a matter of grave importance, and this is closely connected with the question of the best means of avoiding putrefaction. Everything then which tends to make a wound 'do well'—that is, which favours rapid union without, or with the least possible amount of, suppuration, and as perfect an immunity from putrefaction as possible—*pro tanto* diminishes the liability to traumatic fever. It is of primary importance, in surgical operations, so to contrive the incisions that the parts may lie in apposition without tension or discomfort, and that the bloody serum and the products of inflammation which will soon exude from the cut surfaces may find a ready exit; and if this is impossible, to provide an artificial exit for them by means of a drainage tube, or drains of some unirritating substance, such as horse-hair. The position of the patient or of the limb, and all the details of careful and cleanly nursing, are also to be sedulously attended to; and then occurs the important question of how to dress the wound.

In speaking of the subject of the treatment of inflammation, my remarks were confined to the treatment of those cases of inflammation occurring without evident wound. In this place I shall first consider the treatment of inflammation after wounds, and then consider the treatment of the wound itself. It is necessary to make this distinction between the two classes of cases, for in the latter, that is to say, where there is a wound, much may be done to lessen inflammation and keep it within narrow bounds by what has sometimes been termed the 'preventive' treatment of inflammation. The term is a bad one, for our object is not to *prevent* inflammation, without which, of course, the wound could not unite, but to keep it within certain limits, so that it shall not pass beyond that condition which results in the formation of a very small amount of inflammatory exudation just sufficient to glue the edges of the wound together, and to remove any particles of dead tissue, if such be present. Now the injury which produces a wound is momentary, and therefore the inflammation which results from this injury is not long continued but speedily subsides, unless some additional source of irritation is present to further its continuance. This source of irritation is either of a mechanical or chemical nature, which produces a condition of 'unrest' in the part, which favours the condition of inflammation and promotes its continuance. Mechanical unrest is produced, for instance, by the presence of a foreign body in the wound, by the constant movement of a part, by tension, by the weight of a limb dragging on the wound, or in fact anything which produces mechanically an irritation or prevents a condition of absolute rest. The treatment to be adopted for this is to remove the cause

Treatment
of wounds.

of the unrest. Any foreign body must be removed, and perfect rest secured by some means or another; by the application of splints; by supporting the part with sand-bags or some such contrivance; by elevating the limb; by avoiding tension from too tight stitches; by seeing that no part is unduly pressed upon, or that a bandage is not applied too tightly. All these points, trivial as they may appear, make up the sum of the treatment of inflammation as far as regards one of the factors in furthering its continuance, and the best and most successful surgeon will be he who, by attention to these minutiae, obtains for his patient a condition of complete ease from all sources of mechanical unrest.

The subject of chemical unrest is of equal and perhaps even greater importance, since it embraces the whole question of the occurrence of putrefaction in the wound, the products of which are the great source of chemical unrest. We have already seen that in putrefaction, in addition to the presence of a certain amount of water, oxygen, and a certain temperature, which are always present in the body, two factors are necessary for the process to take place: namely, (1) the presence of a putrescible material, and (2) a ferment which shall act as the exciter of the fermentative or putrefactive process, and that if one or other of these factors is absent no putrefaction can occur. The whole treatment of chemical unrest resolves itself therefore into strenuous efforts to banish one or other or both of these factors from our wounds. The chief putrescible animal matter that we find in wounds, and which, by its undergoing putrefaction, forms those chemical products that produce the unrest, is the serum of the blood, expressed from the blood-clots, which, as we have seen, form in the wounded vessels up to the first collateral branch, and also from the inflammatory exudation after it has coagulated. And it is undoubtedly true that if in any given wound we could entirely get rid of this and any other putrescible matter which might be present, we might admit any amount of the ferment to the part, but no putrefaction could take place. Again, as we have already seen, the principal ferment of decomposition is a micro-organism, the *bacterium termo*, which is introduced from without into the wound, and never through the circulation, having been absorbed by the lungs or alimentary canal. Now, if we can so shield our wound as to prevent the introduction of any of these microbes, there may be any quantity of serum or other putrescible animal matter in the wound, but still no putrefaction can take place. Thus it will be seen that we have two means at our disposal for treating chemical unrest, either of which, if perfect in itself, would be quite sufficient to attain our end. And this, it seems to me, is the explanation of the want of agreement among surgeons even of the present day as to the best plan for treating a common incised wound. One group of surgeons by means of scrupulous cleanliness, efficient drainage, and position, aiming at entirely getting rid of any matter from their wounds which is capable of putrefying; another class of surgeons endeavouring by antiseptic dressings to exclude microbes from the wound and destroy any which perchance may have found admission. Of course, no allusion is made here to those infective organisms, which have been before mentioned as one of the causes of inflammation, and which can be introduced otherwise than through the wound, as by the lungs or alimentary canal, since they are capable of living and growing in the living tissues. These can only be combated by germicides or antiseptics which have been proved by experiment to destroy their vitality. It will be seen, therefore, that the treatment of chemical unrest as a so-called

preventive of inflammation is twofold. First, every effort must be made by scrupulous cleanliness, by efficient drainage, and by position to clear the wound of any putrescible animal matter; and secondly, measures must be taken to exclude organisms. The manner in which these are to be carried out will now be considered. The indications of treatment of wounds are six in number—namely, (1) arrest all hæmorrhage; (2) cleanse the wound and remove all foreign bodies; (3) adjust the edges of the wound; (4) provide for free drainage; (5) ensure complete mechanical rest; (6) guard against putrefaction.

1. In a small wound, where no vessel of any size has been wounded, the bleeding will cease after a time spontaneously. Small thrombi will form in the wounded vessels up to the first collateral branch, and thus all further bleeding will be prevented. The causes which conduce to this formation of clots are threefold: (1) Contraction and retraction of the cut end of the vessel, so that the blood has to find its way through a narrowed orifice and over a roughened surface; that is, the tissue from which the vessel has been retracted. (2) Diminished power of the heart's action from faintness due to the shock of the injury and loss of blood, and (3) exposure of the blood to the air, which favours coagulation. When the wound is of greater extent and some considerable sized vessel has been wounded, artificial means will have to be undertaken to arrest the hæmorrhage, and these will be considered in the sequel in the chapter on hæmorrhage.

Arrest of hæmorrhage.

2. All foreign bodies of any size are to be carefully picked out of the wound with clean forceps, and dirt, clots of blood, &c., washed away by careful syringing or irrigation with some antiseptic fluid. It is better to avoid the use of sponges, which not only often prove a source of contamination to the wound, but also, when rubbed over it, have a tendency to displace the little clots in the vessels and cause a renewal of the hæmorrhage.

Cleansing of wound.

3. The means employed for adapting and keeping the edges of a wound in apposition are strapping, bandages, compresses and sutures. Strapping is absolutely necessary in many cases where the sutures have been removed, and the weight of the flaps is so dragging upon them as to make it desirable to relieve them by taking off the strain; and for small wounds which can be kept in exact apposition strapping is more useful than sutures. In such cases the straps should be very rarely disturbed—only when it is plainly required; so, also, when strapping is used to produce pressure in order to restrain hæmorrhage, the longer it is left on the better, provided no œdema of the lower part of the limb is present, and the bleeding is effectually commanded. But in large wounds, such as those of amputations, I cannot say that I am myself very fond of strapping, though I am aware that some very good surgeons use it from the first, to the total exclusion of sutures. The chief reason why I prefer the latter as a means of keeping the edges together is, that the wound thus united requires hardly any dressing, and frequently need never itself be touched; while strapping gets so soon disturbed by the discharges that it must be renewed at very short intervals, a proceeding involving no little pain in an inflamed stump. Other objections to strapping are that it is very difficult to maintain aseptic and is apt to cause tension.

Adaptation of the edges of the wound.

Bandages are often of very great service in obviating the spasms which are so painful in large wounds, such as those of amputation. The support of a splint and bandage lightly and evenly applied seems to me a great comfort after an amputation, and in a severe wound of the thigh or into the knee, I think it a very good plan to bandage the whole limb evenly from the toes.

Again, bandages are very often used to prevent the retraction of the flaps which sometimes ensues after amputation, though this end is perhaps better attained by a loop of strapping well secured to the stump, and acted on by a weight. Compresses are sometimes necessary, and especially in wounds which are the seat of venous bleeding, or bleeding from a number of minute vessels. They should be carefully adapted to the shape of the wound, the first compress (made of about four folds of lint) exactly covering the part on which pressure is to be made, and no more. This is supported by another a little larger, and a third, of still larger size, is laid on the top, and the whole secured in its place by long strips of strapping crossed over the compress, star-wise, and a firm bandage over all.

Sutures.

The principal means at the disposal of the surgeon for maintaining the edges of the wound in apposition is the suture. The different varieties of suture, as regards the structure of which they are composed, and also as regards the manner in which they may be introduced, will be found described in the sequel in the chapter on minor surgery. It may merely be remarked here that by the introduction of sutures alone we do not ensure the adaptation of the whole of the surfaces as well as the edges of a wound. In a case of amputation of the thigh, for instance, the sutures will only serve to bring the edges of the flaps in apposition, and if other means are not taken to prevent it, a large bag or cavity will be left between the surfaces of the flaps, in which blood, serum, or inflammatory products may collect. Of course, drainage is intended to prevent this collection, and drain away any fluid that may be poured out. But it is better, if possible, to prevent this cavity, in which putrescible matter may collect, and, therefore, an endeavour should be made to bring the *surfaces* of all wounds into apposition, as well as the edges, by carefully applied pressure, by means of pads and bandages.

Buried
sutures.

Mr. Keetley calls attention to the importance, in deep wounds, of uniting the cut surfaces of similar tissues (muscle to muscle, fascia to fascia, &c.) by 'buried sutures'—i.e. sutures of carbolised gut, or some other non-putrescible material, by which the whole cavity is at once placed in a position for immediate union. The use of drainage tubes is avoided, the parts are restored at once to their natural function, necrosis of the deeper parts is obviated, and rough depressed scars are avoided. The plan seems to have originated with German surgeons, Werth, Neuber, and Küster. Rapid union is, of course, essential to its success.¹

Drainage.

4. The importance of free drainage cannot, I think, be over-estimated. In fact, it has always appeared to me that the introduction of free drainage is one of the greatest advances of modern surgery. It certainly seems strange that the true use of drainage tubes should have remained so little understood since the days of Chassaignac, who first introduced them into surgery, until almost the present time. The object of the drainage tube, as I have endeavoured to show in the preceding pages, is to carry away all putrescible animal matters from the wound, and there can be no doubt that if the procedure could be carried out in its entirety, we should be able to prevent any putrefaction taking place in a wound, without any means being used to prevent the admission of the ferment of putrefaction. The drainage tube which is most frequently employed in surgery is made of indiarubber, of which the red indiarubber is the best and most durable, but other materials may be employed. Skeins of horsehair or catgut are sometimes used, and possess this advantage, that they may be removed gradually and painlessly, by the

¹ 'Brit. Med. Journal,' May 2, 1885.

withdrawal of each hair or piece of catgut separately, but they are not as efficient as the indiarubber tubing, and, with regard to the catgut, it sometimes becomes dissolved too rapidly, before the purposes for which it was introduced have been fulfilled. Moreover, these materials are useful only in recent wounds, as they can convey serum or serous fluid only, and if suppuration ensues they become practically useless. Glass tubing is sometimes used, especially in draining the peritoneal cavity, and appears to answer admirably for this purpose. Neuber recommends decalcified bone as a drainage, with the object of using an absorbable material. Its use has not been, however, very generally adopted. It occasionally appears to excite suppuration, and sometimes is very long in being absorbed. If indiarubber tubing is employed, there are one or two points in connection with its use which require attention. It should always be cut off on a level with the surface of the wound, otherwise the dressings may turn the end downwards and produce a 'kink,' which will interfere with the free exit of the discharge. It must be retained in this position by some means, otherwise it may slip into the wound. This may best be done by a safety pin, previously rendered aseptic, or by including the tube in the last suture at the angle of the wound. The tube should always be removed as early as possible, the time of its removal depending on the size of the wound and the amount of discharge. Some surgeons remove it at the end of twenty-four hours, but I must confess that in my own practice I have oftener regretted the too early withdrawal of the tube, than its too long retention. It should be withdrawn gradually, a short portion being cut off at each dressing, and always from the most dependent part of the wound.

5. Sufficient has already been said on the necessity for keeping the wound in a condition of complete rest, not only of the limb as a whole, but also of individual muscles. Splints, bandages, and special apparatus in special cases may all be called into requisition and the ingenuity of the surgeon taxed to fulfil this essential requirement.

Mechanical
rest.

6. One method of preventing putrefaction, by the removal of all putrescible matter from the wound has already been described, but there remains also to consider the means by which the introduction of living organisms, into a wound, which may excite putrefactive changes, may be prevented. Certain substances are found to interfere with and destroy these organisms, and these are termed 'antiseptics.' But antiseptics do more than this, not only do they destroy the bacteria of decomposition, but they also prevent the entrance of or destroy those other infective micro-organisms, which, as we have seen, may enter the blood by other sources than the wound, and growing there may give rise to infective diseases—erysipelas, pyæmia, and the like. The necessity is therefore obvious for the employment of antiseptics in the treatment of wounds; as a means not only of preventing putrefaction, which may also be avoided by the withdrawal of all putrescible material, but also of preventing the occurrence of the so-called acute infective diseases. The number of antiseptics used in surgery is very great, and is daily being added to. But *carbolic acid*, the first that was introduced, still holds its own and is largely employed in antiseptic surgery. It was first used by Sir Joseph Lister in 1866, who, searching for some material which should act as a germicide, says, 'I selected carbolic acid, having heard of its remarkable efficacy in disinfecting sewers.' It is not perhaps so powerful as some other antiseptics, still in many respects it is the best. It nevertheless possesses two disadvantages, shared in common with many others, viz. that

Prevention
of putrefac-
tion.

it acts as an irritant when applied locally to the living tissues, and that it may produce general toxic effects. It appears when applied to a wound to increase at first the serous discharge; subsequently it may cause considerable local inflammation and even suppuration. When applied to the skin for a considerable time, as when a wound is dressed with carbolic gauze, especially if the gauze has been wetted in carbolic lotion, it may produce vesication and very considerable irritation. Its general toxic effects generally show themselves first by the urine becoming of a dark-green olive colour. And if the carbolic treatment be now left off, no further symptoms develop themselves, and the urine speedily recovers its natural tint. If on the other hand it is persevered with, vomiting, a rise in temperature, and nervous symptoms, drowsiness or excitement with perhaps delirium may supervene. In order to prevent as far as possible these toxic effects, nothing but the purest acid or absolute phenol should be used. Since I have employed absolute phenol, now for the last five years, I have only had one instance of carbolurea in those cases in which it has been used. Carbolic acid is used in the form of lotion (1 in 20 to 1 in 40), in the form of oil (1 in 5 to 1 in 20), and as carbolic gauze, a thin muslin impregnated with carbolic acid, resin and paraffin.

Salicylic acid is an excellent antiseptic, though not so powerful as carbolic acid, and possesses no toxic qualities. It is moreover non-volatile, but is very irritating to the skin, and especially to the mucous membrane of the nose. When its fine dust finds its way into the nasal cavity it produces the most violent sneezing. It is not used as a lotion on account of its sparing solubility. It is principally employed in the form of salicylic wool or jute and then forms an admirable packing material. It is also used in the form of an ointment and sometimes as a powder, mixed with starch, to sprinkle over the surface of ulcers.

Eucalyptus oil is frequently used as a substitute for carbolic acid in the preparation of gauze. It is a powerful antiseptic, possesses no poisonous effects, and has a somewhat pleasant fragrant odour. It is not however so trustworthy as carbolic acid, as it is very volatile, and gauze which has been impregnated with it soon loses its antiseptic properties.

Boracic acid is a weak antiseptic, but is a useful preparation in some cases. It is used principally in the form of boracic lint or as an ointment. Boracic lint is made by steeping ordinary lint in a hot saturated solution of boracic acid and before it is applied it is again moistened with boracic lotion. It is a useful application where warmth and moisture are required, and is also applied to granulating wounds after the stronger antiseptics have been discarded. It is also extensively used for washing out large cavities, such as the thorax and abdomen.

Iodoform is one of the most useful antiseptics, its chief objection being its disagreeable odour. It is used as a powder to sloughy surfaces and is especially useful after operations in any of the cavities of the body, as, for example, after removal of the tongue, keeping the stump perfectly sweet and aseptic and doing away with one former source of great danger after this operation, viz. septic pneumonia from the patient inhaling air poisoned by passing over the sloughy wound. Iodoform is also used in the form of gauze and as an ointment, when the addition of a few drops of oil of bitter almonds will entirely destroy its unpleasant odour. Iodoform is largely used by Esmarch as a dressing for wounds, and his success has been unprecedented. He applies to the wound, having first inserted

a decalcified bone drainage tube, pads soaked in iodoform and absolute alcohol, then an iodoform bandage. Over this he packs in a large quantity of gauze, and after bandaging with a moist bandage, he applies an elastic bandage so as to make firm and equable pressure. By this means he combines pressure with antiseptics. By some, however, iodoform is regarded as by no means a potent germicide. It was shown by Sir Joseph Lister some years ago that 10 per cent. iodoform wool soaked with milk underwent a lactic fermentation, and other experimenters have proved that even 50 per cent. of iodoform does not destroy germ life. But there was one important fallacy in these experiments, and that was that the mixture was not maintained at the temperature of the body. When this is done, the micrococci of pus in the presence of moisture have the power of decomposing iodoform, setting iodine free, and it acts as a powerful germicide, when used in connection with wounds and suppurating surfaces. *Iodol* is said to possess the same antiseptic properties as iodoform, but without the smell; most observers, however, regard it as quite useless. The great disadvantage in the use of iodoform is the marked poisonous properties which it possesses. The symptoms are elevation of temperature, headache, restlessness, thirst, rapid pulse, and in some cases delirium, hallucinations and sleeplessness. The urine will be found to contain iodine.¹

Corrosive sublimate is one of the most powerful of antiseptics, and its use seems to be for certain purposes superseding that of carbolic acid. The great objections to its use are its poisonous character, its action as an irritant, and its effect upon steel instruments. Its toxic effects are those of mercuric poisoning, diarrhoea, with sometimes bloody stools, swollen and ulcerated gums. It is principally used for the irrigation of wounds, and is especially valuable in washing out the peritoneal cavity after the operation of abdominal section, especially if the peritoneum is inflamed. For this purpose, however, it should not be used of a greater strength than 1 in 4,000, and care should be taken that none is left behind in the peritoneal cavity. It should never be employed where there is any disease of the kidneys, as these patients are peculiarly susceptible of its toxic influences. It is sometimes employed dissolved in serum to saturate gauze, as a dressing for wounds. Serum is employed instead of water because it is believed that it diminishes the irritation caused by the sublimate.²

A double mercuric salt formed by the sublimation of a mixture of corrosive sublimate and chloride of ammonium has been lately introduced. It is named *Sal Alembroth*. It appears to possess powerful antiseptic properties, but in the cases in which I have employed it I have found that it has produced very considerable irritation of the skin, and I have, therefore, abandoned its use.

Chloride of Zinc is both efficient and cheap, and is especially useful in washing out putrefying sinuses. It may be employed in solution of the strength of 40 grains to the ounce. Many other antiseptics might be mentioned; Peroxide of Hydrogen, highly commended by Mr. John Wood; Bismuth by M. Gosselin; resorcin, permanganate of potash, etc. *Salol* (salicylate of phenol) has lately been introduced. It is said to be as potent as iodoform, without its poisonous effects or disagreeable smell. It has not, however, yet been sufficiently tested to express any opinion on its merits.

¹ See a paper by Mr. Treves ('Practitioner,' Oct. 1886) in which he discusses the whole subject of iodoform poisoning.

² See an address by Sir Joseph Lister at the Medical Society of London, vol. viii. p. 2.

In order to illustrate the practice of antiseptic surgery, I propose now to describe the various steps of an operation undertaken with 'antiseptic precautions.' The day before the operation the part to be operated upon should be carefully rendered aseptic. Having first been shaved, if necessary, it is to be thoroughly washed with soft soap or potash soap, and then well sluiced with carbolic lotion (1 in 20). It is then to be dressed with carbolic gauze and jaconet, which is to be retained by a bandage and allowed to remain until the moment of the commencement of the operation. Some time previous to the operation (half an hour at least) all instruments which can possibly be required, and which must have been previously scrupulously cleaned, are to be placed in a flat open dish and *covered* with carbolic lotion (1 in 20), and the surgeon should assure himself that his sponges and ligatures are aseptic.¹ While the anæsthetic is being administered the surgeon and his assistants should proceed to purify their hands, especial care being paid to the nails and skin around them, which should be well brushed with a nail-brush. For the cleansing of the hands a 1 in 40 solution may be employed with carbolic soap, and immediately before commencing the operation the hands may be plunged in a 1 in 20 solution, or, what is better, in warm corrosive sublimate lotion (1 in 1,000) as it does not irritate the skin like the strong carbolic lotion. The patient being now under the influence of the anæsthetic, and the parts around the site of the proposed operation and the clothing being protected by macintoshes and towels wrung out in carbolic lotion or solution of corrosive sublimate; the spray, if this is to be used, is to be turned on and the dressing which was applied the day before removed. The part is now again to be well washed over with carbolic lotion before the operation is commenced. The carbolic spray is now often dispensed with by surgeons in antiseptic operations and irrigation substituted in its stead. There can be no doubt that there are some minor inconveniences attending the use of the spray, and experience seems to show that irrigation answers every purpose, so that it seems probable that the former will fall more and more into disuse. There is, however, one way in which I think the spray may be still usefully employed, and that is in purifying the air of the room in which the operation is performed. I think it is desirable and useful to keep the spray at work for an hour or two prior to the performance of any operation, so as to destroy any bacteria which may be floating in the air, and then it may be discarded during the operation and irrigation substituted.

The operation is now performed, an assistant standing by and irrigating the wound, preferably with corrosive sublimate lotion, whenever he sees a favourable opportunity without interfering with the manipulations of the operator. All bleeding vessels are to be twisted or secured with aseptic ligatures, which are to be cut off short. The efficient drainage of the wound is to be provided for in the manner described above and the wound closed with sutures. The parts having now been thoroughly cleansed with carbolic or mercuric lotion, the dressing may be proceeded with. First, a piece of protective, immediately before dipped in carbolic solution, and a little larger than the wound itself, is placed over the wound. This is covered by about eight layers of carbolic gauze, which has been wetted in carbolic lotion, and is sufficiently large to overlap the wound considerably. This is to be surrounded, especially at its margins, by packing (salicylic wool), and over this is placed the dry dressing, consisting of some

¹ Sponges and ligatures should always be kept in carbolic acid solution.

eight, ten, or twelve layers of gauze, sufficiently large to cover in the 'deep dressings' and overlap their margins to a considerable extent, and the whole is covered by a sheeting of thin macintosh (jaconet), which has just before its application been rinsed in carbolic lotion. The whole of the dressing is then fixed with a carbolic gauze bandage, which is especially made to encircle the limb or part beyond the margin of the dressing, so that no space shall be left between the edge of the dressing and the skin, through which germs might be introduced. Some surgeons, to attain the same end, sometimes apply an elastic webbing round the edge of the dressing.

Another form of dressing, which I constantly employ, is to sprinkle the surface of the wound with iodoform, then cover it with eight or ten layers of iodoform gauze, and finally several layers of salicylic wool, so that the part is enshrouded in at least three inches in depth of this material. Under these circumstances no jaconet is required. This, it will be noted, is a perfectly dry dressing, and I am strongly of opinion that the less moisture there is about a wound, the better the result. The object in wetting the deep dressing is to cause the diffusion of any discharge that may take place from the wound through it; but I think the moisture acts injuriously, and, since I have adopted a dry form of dressing, I am convinced that my cases have done better. So, also, in subsequent dressings I avoid as much as possible the application of fluid, as in syringing out the wound or tube, or soaking the skin around with antiseptic solutions, provided, of course, that the wound is doing well and there is no suppuration.

I am a very great advocate for always dressing the wound again within twenty-four hours of the operation, in order that all the dressing, which has become more or less soaked by the oozing of blood and serum, should be got rid of. This should be done under the spray or with careful irrigation, and the wound not exposed more than is absolutely necessary. The subsequent dressings should be performed according to requirements, the two indications for this necessity being a rise in temperature over 101° F. and the appearance of any discharge at the margin of the dressing. No antiseptic dressing should be, however, I think, allowed to remain a longer period than a week without renewal.¹

¹ In connection with this subject I would refer the reader to Mr. Keetley's 'Index of Surgery,' where that gentleman describes 'How *not* to practise antiseptic surgery.'

CHAPTER II.

THE COMPLICATIONS OF WOUNDS AND INJURIES—ABSCCESS—SINUS
AND FISTULA—ULCERATION—PYLEMIA—HECTIC—ERYSIPELAS—
GANGRENE—TETANUS—DELIRIUM TREMENS.

Abscess.

WE must now consider the complications which interfere with the regularity of the healing process, and the specific diseases which, taking their rise in unhealthy inflammation or disturbed innervation excited by the injury, affect the whole system, and too often render what at first seemed a trivial accident very serious or even fatal. All of these complications also originate spontaneously from diseases of all sorts; but they are most conveniently studied in relation to wounds. We will begin with abscess, a frequent concomitant of all kinds of injuries, and an equally frequent idiopathic affection.

Suppuration.

An abscess is defined as a collection of pus enclosed in a cavity. And pus is formed as the result of suppuration, one of the results of inflammation, cause, the inflammation is prolonged, so that the migration of leucocytes and transudation of inflammatory exudation is excessive. Under these circumstances the leucocytes accumulate in the tissues outside the vessels, possibly there undergoing proliferation, press upon and absorb the original tissues of the part, so that eventually instead of these tissues we have nothing but a mass of round cells (leucocytes or their descendants) in a quantity of inflammatory exudation. These cells towards the centre of the mass, that is to say, at the part farthest removed from nutrition, degenerate and perish from inanition, fluid soaks in from surrounding parts, and we have the original tissue replaced by a creamy fluid, *pus*, consisting of the degenerated leucocytes floating in a clear, colourless fluid. These bodies are now named *pus corpuscles*, while the fluid in which they float is termed *liquor puris*. Pus-corpuscles, as seen out of the body, are but little different in appearance from leucocytes. The leucocyte, when treated with acetic acid, displays the appearance of a nucleus in its interior, that appearance being usually regarded as the result of a shrinking of the protoplasm of which it is composed. The pus-globule is frequently many-nucleated when treated with acid, a condition which Rindfleisch regards as indicating a tendency to degenerate and break down. But the same author says that many of the corpuscles of pus display no difference whatever in character from the blood leucocyte, having only single nuclei, showing, when fresh, the same amoeboid movements, and being, in fact, obviously the same things both in structure and function.

Kinds of pus.

Healthy pus is a creamy, inodorous, yellow, homogeneous, alkaline fluid. This was called by the old authors *pus laudabile*. When mixed with blood, as

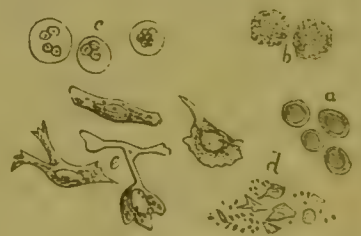


FIG. 3. Pus-corpuscles. *a*. From a healthy granulating wound. *b*. From an abscess in the areolar tissue. *c*. The same treated with dilute acetic acid. *d*. From a sinus in bone (necrosis). *e*. Migratory pus-corpuscles. — From Rindfleisch's 'Pathological Histology.'

it often is in acute abscess, it is called *sanious*; when it has putrefied, from acute inflammation or from gangrene of the parts in which it is formed, it is termed *offensive* or *putrid*; when mixed with flakes of solid matter, *curdy* or *flaky*; and when these flakes are believed to be fragments of crude tubercle, *strumous*; when excessively thin, as in chronic abscess, *serous* or *watery*; when thin and acrid, so as to irritate the skin in the neighbourhood, *ichorous*. Finally, in rare cases, pus presents various colours--blue, green, or black.¹

The cavity consists internally of the hyperæmic granulation tissue called the pyogenic membrane (which is more distinct in chronic abscess of bone than in any other kind), immediately external to which is tissue degenerated by inflammation, and containing a large number of dilated vessels, then cedematous cellular and other tissues, gradually fading away into healthy parts. The enlargement of the vessels around the abscess is often so great as to give rise to pulsation obvious to the eye as well as perceptible to the patient. As the surrounding tissues soften and break down the abscess-cavity extends; and this usually occurs more towards the nearest surface than in other directions, until the tissues over the pus become so much thinned that it projects and its colour can be seen, when the abscess is said to *point*, and this immediately precedes its bursting.

The abscess-cavity.

Progress and bursting.

The kinds of abscess are acute and chronic, or cold, to which French authors add abscesses by congestion. The latter are such as are in contact with a diseased surface of bone, from which their matter is furnished, as is the case in spinal abscess.

Kinds of abscess.

The most common are the acute abscesses which depend on some definite irritation giving rise to inflammation. They advance rapidly, with pain, and, if large, with constitutional symptoms. A large abscess is usually preceded by rigors, and probably accompanied by perceptible fever. The parts around are swollen, hot, and painful, often very tense and pulsating; the pus is generally healthy, or sanious. A cold abscess advances very slowly and gradually to a large size, with no fever, and generally little or no pain; the parts around are somewhat thickened and hardened by inflammatory effusion and chronic organisation, but otherwise hardly altered, except by mere distension; the pus is usually watery or curdy.

The diagnosis of abscess has to be made from mere inflammation with œdema, from soft solid tumours (such as soft cancers), from cystic tumours, and from extravasations of blood.² The first point in the diagnosis of abscess is to become perfectly familiar with the sensation of *fluctuation*. The particles of fluid in a cavity, if not too tightly bound down by its walls, are displaced in any direction by the slightest force, and immediately return again to their former position. Thus if one hand or one finger be placed on a dropsical abdomen while any other part of the belly is tapped gently with the other hand or another finger, the wave of fluid will be plainly felt to impinge on the hand or finger which is at rest; or if the thumb be sharply pressed down on a small deep-seated collection of fluid, the fluid yields and will be felt to surge up again against the thumb. The perception of fluctuation, in either of these ways, distinguishes a limited collection of fluid like an abscess from the indefinite softness of fluid diffused in the meshes of the tissues and also from solid tumours; and the history of the case, with the presence of inflammation in its neighbourhood, will distinguish an abscess

Diagnostic signs.

Fluctuation.

¹ See 'System of Surgery,' vol. i. p. 99, 3rd ed.

² Abscesses may also be confounded with aneurism: but this will be treated of with the latter subject.

from a cyst or a collection of extravasated blood ; but in case of doubt the grooved needle, exploring trocar, or Dienlafoy's aspirator will settle the question. The fallacies in detecting fluctuation are numerous. There may be fluid, but it may be so tightly bound down that its displacement is imperceptible. This is very common in small tense cysts and in hydrocele, less so in abscess, except in thecal and perinæal abscesses. There may be fluid, and in considerable quantity, permeating the tissues so extensively as to give the sensation of fluctuation, though there is no cavity. Thus inflamed soft parts are sometimes incised, under the impression that there is an abscess, when it turns out to be only inflammatory œdema. This argues, to some extent, a deficiency in the *tactus eruditus* on the part of the surgeon, but it is not uncommon even with the most experienced, and often relieves the inflammation more effectually than anything else could have done. A still greater difficulty is to distinguish the sensation of deep-seated fluid from that of a soft tumour, such as a rapidly-growing cancer ; in fact, it is hardly possible, so permeated with fluid is the texture of such tumours. Here, again, exploration is essential.

**Treatment
of abscess.**

The diagnosis of abscess having been made, the question occurs of opening it. As a general rule all abscesses are better opened at once, except those which are very deeply seated, which may require less extensive incision if allowed to come nearer to the surface. In parts also where deformity is especially to be avoided, as in the neck, it may be better to wait until a mere puncture will suffice, and till the surgeon can see exactly which is the most depending part of the fluid.

There are many different kinds of abscess-knife. One of the best is that which goes by the name of Syme, a sickle-shaped blade, which is plunged into the abscess and cutting rapidly outwards makes a sufficient incision with very little pain. A small knife, which is called Pollock's knife at St. George's, but has different names with different instrument-makers, is very useful, as it makes hardly a larger puncture than an exploring-needle, and so can be withdrawn, if there be no pus, without doing any damage, yet is strong enough to open any ordinary abscess.¹ A very useful method of opening large abscesses is under carbolic acid. A *veil* or thin rag steeped in the ordinary carbolic lotion (1 part in 40) is laid over the part, the knife is passed under this veil, and as the incision is made the veil is smoothed down over it, so that no air enters. The pus is allowed to ooze out through this veil, and in about an hour, when the discharge has pretty well ceased, a drainage tube is inserted, and the wound is dressed after the ordinary antiseptic method. Frequent washing out of the sac with carbolic lotion was recommended by the late Mr. Callender, and seems often to expedite the



FIG. 4. 'Syme's'
Abscess Knife.



FIG. 5. 'Paget's' or 'Pollock's'
Abscess Knife.

¹ A groove is sometimes cut along the middle of the blade so as to convert the knife into a kind of broad grooved-needle.

cure; but the over-distension of the sac which he practised does not seem to me advisable.

When the abscess is very deeply seated or lies in the neighbourhood of important structures, as in the neck, a very safe and valuable method is that which is especially recommended by Mr. Hilton¹ of laying aside the knife after the superficial parts have been freely incised, and breaking into the cavity of the abscess with the end of a director. A pair of forceps can then be inserted into the small hole so made, and by opening the blades the orifice may be enlarged as far as needful.

Inflammation of the cavity of a large abscess after incision, occurring in cases where the discharge is allowed to become septic, is attended with very grave symptoms—rigors, fever, œdema of the parts, and putrefaction of the matter. The wound must now be freely enlarged, and the cavity washed out constantly with some antiseptic, while the patient's strength is supported with stimulants and tonics, and opium used as may be indicated.

Inflamma-
tion of the
cavity.

Another matter which should be noticed in connection with abscess is, that when opened the sides of the cavity begin to granulate freely; and often if the opening is not free enough the granulations will become congested and a continuous oozing of blood (*hémorrhagie en nappe*, as the French term it) will take place. Styptics, pressure, &c., are constantly used in such cases, and aggravate the mischief. If the cavity be laid freely open from one end to the other, and if need be by a crucial incision, the relief of the tension and the consequent exposure of the granulations to the air will at once suppress the bleeding.

Hæmor-
rhage from
wall of
abscess.

Finally, it should be added that abscesses sometimes entirely disappear without bursting. If an opportunity offers for examining the part after this has taken place, a caseous, semi-solid substance called 'adipocere' is found occupying the diminished cavity and surrounded by traces of the wall of the abscess. Ultimately even this may disappear, and there may be left either a little chalky mass or nothing but a confused induration of the tissues.

Disappear-
ance of
abscesses.

In the remains of old dried-up abscesses, or in other residues of inflammation which have never advanced to suppuration, abscess is very likely to occur a considerable time after apparent recovery. Sir J. Paget has called especial attention to these 'residual abscesses' in his *Clinical Lectures* (p. 310). They are most common after spinal abscesses, and are also common after abscesses connected with diseased joints, but they occur in any part which remains altered and degenerated in texture—'in the thickenings, adhesions, or other lowly-organised products of inflammation long past.' The prognosis of these abscesses is, as a rule, better than that of the original disease on which they supervene. They should be opened at once.

Residual
abscess.

Very commonly, after it has burst, an abscess remains open, but its cavity narrows into what is called a 'sinus' or 'fistula.'

Sinus and
fistula.

These two terms are sometimes used as synonymous, meaning a long channel like that of a pipe running through the soft or hard parts, but at other times some differences are made in the use of the words. Speaking generally three kinds of sinus or fistula are described, viz.: 1. Long narrow suppurating canals (e.g. fistula in ano, mammary sinus); 2. Canals giving unnatural exit to secretions (e.g. gastric fistula, biliary fistula); and 3. Unnatural apertures of communication between mucous canals or cavities (e.g. vesico-vaginal fistula). 'If a distinction is to be made between the terms, *fistula* should be applied

¹ See Hilton on 'Rest and Pain,' lect. vi. Paget, 'Clinical Lectures and Essays,' p. 333.

to the second and third of the above-named three forms of disease, and to those examples of the first form in which the suppurating canal has two openings; and *sinus* should be applied exclusively to those of the first form in which the canal has but one opening.' (Paget.) The special forms of fistula will be considered, so far as they are the subjects of surgical treatment, in subsequent chapters, as fistula in ano with DISEASES OF THE RECTUM, vesico-vaginal fistula with DISEASES OF THE FEMALE GENERATIVE ORGANS. We need only here occupy ourselves with those sinuous or fistulous passages which result from the imperfect healing of old abscesses. This imperfection results most commonly from some abiding source of irritation either at the bottom or in the track of the fistula, such as a piece of diseased bone or a lodged foreign body; sometimes from muscular action disturbing the parts, sometimes from the imperfect exit, causing retention of the matter and consequent inflammation of the walls of the cavity; sometimes, as it seems, from mere ill health, interfering with the tendency of the cavity to fill up. The walls of an old sinus will always be found more or less inflamed, condensed, and unhealthy, and very frequently secondary pouches, or suppurating cavities, exist in the walls, or the sinus divides into two or more channels which open independently of each other.

The main points in the surgical treatment of sinuses are: first to ascertain whether any foreign body is present, and if so to remove it; next to ascertain whether the sinus depends on disease of some bone, and in that case to remove the bone if loose, and if carious to treat the disease according to the rules laid down in the chapter on DISEASES OF BONE. Simple sinuses which are kept up by the action of muscles may be cured by the division of those muscles (of which the division of the sphincter in anal fistula is a familiar example), or by pressure so applied as to keep the muscles at rest.¹ Sometimes the morbid action of the parietes of the sinus may be modified by injecting it with some irritating fluid, as the tincture of iodine or of cantharides, or by lightly cauterising it with the galvanic cautery; and the same effect may in other cases be produced by a seton or a drainage-tube. In some few cases besides those mentioned above, pressure may act advantageously by bringing the deeper or remoter parts of the sinus in contact and keeping them so till they unite and thus close the sinus gradually from the bottom. Sometimes the dilatation of the sinus with the sea-tangle tent converts it into a simple abscess which fills up. But the surest plan, when it can be thoroughly carried out, is to lay open the whole sinus and every branch of it, dissect or scrape away the indurated walls of the sinus, if necessary, and make the entire wound granulate from the bottom.

Ulceration.

In connection with the process of suppuration which we have now been considering, I must allude to another result of inflammation, which is identical with suppuration as a pathological process, but differs from it in its clinical manifestations. This process is ulceration. It is usually defined as 'molecular death,' and consists in a progressive destruction of tissue, without the separation of visible masses of dead matter, the part appearing to become liquefied and converted into discharge which is exuded from its surface. It is identically therefore the same process as suppuration, only there the discharge which was produced by the liquefaction of the tissues was retained and pent up in a cavity formed by this liquefaction, whereas in ulceration the discharge is at once got rid of, and the cavity alone remains. Ulceration may therefore be described as suppuration on a free surface. In this process there

¹ Some interesting and practical examples of this use of pressure are recorded by Mr. Hilton on 'Rest and Pain,' lect. vi.

is first inflammation, with its attendant hyperæmia, stasis, and emigration. This latter stage continues until the part becomes crowded with leucocytes, which press upon, absorb, and replace the natural tissues of the part. The leucocytes then, in their turn, undergo degeneration, probably from malnutrition, and become converted into pus corpuscles, which are at once poured off from the surface, and not collected and pent up in a cavity as they would be in the formation of an abscess. We have thus a progressive destruction going on and an ulcer formed, the base of which is composed of hyperæmic granulation tissue, which is simply the analogue of the pyogenic membrane of an abscess. When the source of irritation is removed, the process ceases and repair takes place. The surface of the wound becomes covered over by a layer of granulations, exactly in the same way as has already been described in speaking of union of wounds by second intention. That is, the granulation tissue, or inflammatory lymph forming the basin of the ulcer, having become vascularised no longer perishes from malnutrition, but becomes converted into granulations. To the naked eye, or under a lens of low power, these granulations look something like coarse red velvet, that is to say, the surface is studded with innumerable small red projections, which are concealed by the pus and serous fluid exuding from the wound, but are brought into sight by gently drying it. If one of these granulations be examined with the microscope (Fig. 6) after having been artificially hardened, it will be seen to



FIG. 6. Vertical section through the edge of a granulating surface in process of repair (after Rindfleisch). *a*. Secretion of pus. *b*. Granulation tissue (embryonic tissue) with capillary loops, whose walls consist of a layer of cells longitudinally disposed; their thickness decreases as we approach the surface. *c*. Cicatrization beginning at the base (spindle-cell tissue). *d*. Cicatricial tissue. *e*. Fully-formed cuticle, its middle layer consisting of grooved cells. *f*. Young epithelial cells. *g*. Zone of differentiation.

be composed chiefly of a collection of larger granular cells, with pus cells on the surface and fibre cells at the deeper parts; intermingled with these cells are new vessels which shoot into the granulations from the capillaries of the wounded or inflamed surface, and the whole is permeated with fluid.

The cavity of the wound is closed by the constant organisation of the deep parts of these granulations, as the superficial parts melt away into pus, and ultimately, by the formation of epithelium over the surface. This epithelium is formed by the multiplication of the natural epithelium on the edge of the sore, and in all probability never from the cells of the granulating surface.

The subject of ulcers will be treated more in detail in a subsequent chapter, but there are two special points in connection with the treatment of these conditions which it seems more appropriate to allude to in this place, since the treatment is applicable to the class as a whole and not to any particular division or group. They are processes which have recently been introduced for artificially hastening the cicatrisation of large granulating surfaces.

Skin-graft-
ing.

The first of these is by the method of skin-grafting invented by M. Reverdin of Geneva, and introduced into this country by Mr. Pollock.¹ For the success of this process it is essential that the granulations should be perfectly healthy, and that all irritation in the sore should have ceased—i. e. that the ulcer should be prepared to cicatrise—and it is at any rate desirable that the patient's general health should be good. Then, if a small piece of the surface of the skin, consisting of little more than its epithelial layer, be laid on the granulations and left undisturbed for a few days, it will often form a nucleus from which cicatrisation will extend rapidly in all directions, as it sometimes does from the islands of skin which may be left undestroyed in the centre of an ulcer. The pieces grow best when planted not far from the edge of the sore (say about half an inch), so that the sore can first be diminished by a zone of skin-grafts planted all round its margin, and then the operation be repeated, and so on, until it is all covered. The growth of the graft seems to depend on the cells of the rete Malpighii. Attempts have been made to produce the same effect by grafting merely the cells scraped from the surface or loosened by a blister, but such cells are as a rule effete and will not grow.² Nor is there any proof that the tissue of the cutis itself, and still less the subcutaneous cellular tissue, take any part in the new formation. The red bud-like appearance which the graft presents for the first few days after its insertion is doubtless due, as Dr. Page points out, to the desquamation of the effete superficial layers of the transplanted epidermis, and to the transparency of the cells of the rete mucosum, allowing the colour of the subjacent parts to show through them.

It is best, I think, to take up a small portion of the true skin as well as the epidermis, in order to make sure of removing the rete mucosum, but on no account should the whole thickness of the skin be cut through. An ingenious combination of fine forceps with scissors enables the surgeon to remove a small piece with hardly any pain at all; but when this is not at hand a pair of fine forceps and sharp curved scissors answer the purpose.³ The grafts should be very small, hardly larger than a pin's head. They

¹ M. Reverdin's original patient was presented to the Soc. de Chirurgie de Paris on Dec. 8, 1869 ('Bull. de la Soc. de Chir.' Nov. 27, 1871). Mr. Pollock's first case was published in the year 1870.

² See an interesting paper on this subject by Dr. Page of Edinburgh, 'Brit. Med. Journ.,' March 27, 1871.

³ The pieces are generally taken from some other part of the patient's own body; but the process of cutting them is so little painful that often a bystander offers his arm for the purpose. They should be taken from a part where the skin is quite healthy, thin, and supple. If any difficulty should arise in obtaining grafts, Dr. Allen of Leadgate, Durham, recommends the substitution of bits of skin from a decapitated frog, a plan of which I can speak very highly as in my practice it has been followed by admirable results

should be laid firmly on the granulations, about an inch apart ; and if the patient can be trusted not to disturb them in any way, I think they are best left exposed for a few hours. After this, or at once, if there is any danger

of their being disturbed, they should be covered with oiled silk, moistened with oil to prevent it sticking when removed, and the whole fixed with strapping and covered with cotton-wool. They should then be left undisturbed for three or four days and redressed as before. At first

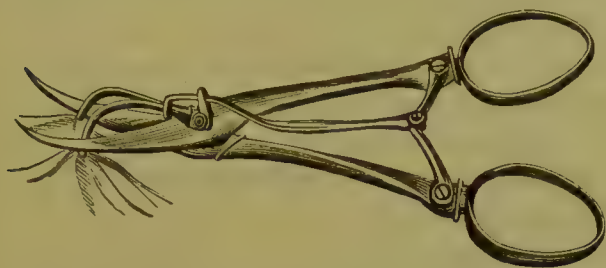


FIG. 7. Skin-grafting scissors. The piece of skin which is shown in the grasp of the forceps is larger than would be taken in practice.

they change into little round, vascular-looking buds, which sometimes become almost imperceptible at first in the neighbouring granulations, but afterwards the new cuticle is seen extending in all directions from the bud. That this new cuticle is formed by growth from the old is proved by the fact that when black skin is engrafted on an ulcer in a white man, as recorded by Mr. Bryant, or when the reverse experiment is made, as in a case in my own practice, the newly-formed skin is of the colour of the graft to the extent due to the action of the latter. My own experience, as far as it has gone, leads me to believe that the cicatrix formed by skin-grafting is more highly organised and less liable to all forms of degeneration than that which is produced by the slower natural process.

The other process to which I alluded is known as 'sponge-grafting.' The proposal was originally made by Mr. Hamilton,¹ now Professor of Pathological Anatomy at Aberdeen, to fill a granulating cavity with sponge, previously decalcified and rendered aseptic by steeping in carbolic acid. The objection to the plan as originally proposed is that these large pieces of sponge retain the discharge, putrefy, and often retard, instead of promoting, the healing of the wound. As now modified the sponge is cut into thin slices, in a freezing microtome, and these are applied with moderate pressure on the granulating surface. When they seem to have become organised by the sprouting of the granulations into the interstices of the sponge, fresh layers are applied till the cavity is filled up. The framework of sponge appears to be organised in the same sense as carbolised catgut ligatures are said to be, i.e. its place is occupied ultimately by organised tissue.²

Sponge-grafting.

The terms 'Septicæmia' and 'Pyæmia' have been somewhat vaguely applied, and it is difficult sometimes to understand what is meant by them. This is especially true with regard to septicæmia, which by some is used as analogous to traumatic or wound fever ; by others is applied to a fever caused by the introduction into the blood-stream of a poison generated in a wound ;

Sapraemia, septicæmia, pyæmia.

(see 'Lancet,' Nov. 15, 1884, p. 875). Mr. Clement Lucas recommends the surgeon when he is performing circumcision to seize the opportunity and use the portion of prepuce removed for skin-grafting on any cases which may require it ('Lancet,' Oct. 4, 1884, p. 586), and Mr. Chauncy Puzey of Liverpool records notes of a very interesting case in which this was done ('Lancet,' Oct. 18, 1884, p. 676).

¹ 'Edinb. Med. Journal,' Nov. 1881.

² The reader may refer to some papers in the 'British Medical Journal,' Dec. 16, 1882, by Drs. Sanctuary and Ferguson ; Jan. 6, 1883, by Prof. Hamilton ; and June 13, 1883, by Mr. Perkins.

by others to an acute infective disease, produced by the inoculation of a specific poison, probably a micro-organism; and by others, again, as simply blood-poisoning. It is as a *septic disease*, due to the introduction into the blood of a poison, probably a micro-organism, which is capable of multiplying in the system, that the term *septicæmia* will be here used. Those forms of febrile disturbance which are due to the introduction of a poison generated in a wound, and which poison has not the power of multiplying in the system, will be described as cases of *Sapræmia*, a term which is now coming into use; while the term *Pyæmia* will be applied to those cases of septic disease, due to the introduction into the blood-stream of an infective poison, in which there is a local manifestation of the disease in the shape of multiple collections of pus in various parts of the body, as embolic abscesses in the viscera, suppuration in the serous cavities and joints or in the subcutaneous connective tissue. It must be admitted, however, that this definition of *pyæmia* is not perfect, for the virulence of the poison may be so great that the patient may succumb before the suppuration has time to develop; and again, we may get multiple local suppurations, which are believed to be *pyæmic*, without any evidence of general infection; but it is sufficiently definite to mark the distinction between *pyæmia* and *septicæmia*.

Sapræmia.

By *sapræmia*, or 'septic intoxication,' as it is sometimes called, is meant a febrile condition which is due to the introduction into the blood of a chemical poison generated by the decomposition or putrefaction of dead animal matter in a wound. It must not be confounded with traumatic fever, which, as we have already seen (see p. 14), is probably in a great measure due to poisoning by the so-called blood-ferment, and may be present without any putrefaction. This chemical poison has been named 'sepsin' and may be prepared artificially. If some putrid meat or fibrine is digested in water and then filtered, and boiling alcohol added to the solution obtained by filtration, a precipitate is formed; this may be dried and then redissolved in water and a perfectly clear fluid obtained which, if injected into an animal, will produce all the symptoms of *sapræmia* or septic intoxication. It will be found that the effects produced by the poison will be exactly proportional to the dose. If the dose is small, certain symptoms will result, varying in their intensity with the amount of the dose, but the animal will recover. If, on the other hand, the dose is large, the symptoms will be more intense and the animal will die with greater or less rapidity, according to the amount of the poison injected. In this experiment it is quite clear that the poisoning is not due to the introduction of any septic organism, for the fluid injected was a clear solution perfectly free from any morphological elements. Moreover, the symptoms set in immediately after the introduction of the poison, and were not delayed, while any microbes, which might have been introduced, were multiplying in the blood. So that the poison is non-infective, and in further proof of this it should be mentioned that the blood of an animal killed by this poison, if inoculated into another animal, produces no effect at all. *Sapræmia* is therefore a condition in which poisoning takes place from the introduction into the system of a chemical poison, just in the same way as the hypodermic injection of morphia or any other toxic drug produces poisoning, and the effect of the poison is in direct proportion to the dose.

The symptoms of *sapræmia* are as follows: as soon as putrefaction commences in a wound, and its products begin to circulate in the blood, a disturbance of the nervous system shows itself. The patient feels ill and com-

plaints of headache and loss of appetite. There is nausea and vomiting. There is a rise in the temperature to 102° F. or 103° F., and possibly a rigor. Shortly, disturbance of the alimentary canal asserts itself; there is diarrhœa, sometimes bloody, and constant sickness and vomiting. The tongue is furred, the pulse quick and weak, the skin clammy, and the urine deficient in quantity and concentrated. Finally, in fatal cases, delirium comes on, followed by coma and death. In very acute cases where the dose of the poison absorbed has been very large, there is collapse from the first: the pulse is feeble, very quick and irregular, the tongue dry and brown, and the teeth covered with sordes. There is muscular twitching and restlessness, constant diarrhœa, soon becoming bloody, dyspnœa, delirium, loss of consciousness, and death. The great characteristic of sapræmia as regards its symptoms, in contradistinction to septicæmia, is the fact that if the putrefactive tissues are removed, that is to say the limb in which putrefaction is going on amputated, or the wound thoroughly washed out, disinfected and drained, the symptoms begin to subside immediately, whereas in septicæmia this is not the case.

The post-mortem appearances are not characteristic. The blood is found to be uncoagulated and of a 'tarry' consistence. There is marked congestion of the internal organs, especially of the mucous membrane of the gastrointestinal tract. The lungs are congested, and the serous membranes of the pleuræ and pericardium covered with minute extravasations of blood. The liver and kidneys are congested and the spleen soft and diffuent. Putrefaction is noticed to come on very rapidly after death in these cases.

The treatment of sapræmia in a simple uncomplicated case is usually easy and the prognosis good. But it must be borne in mind that this disease is very often complicated with some infective mischief, and that symptoms of pyæmia may develop themselves in a few days. In any uncomplicated case the treatment consists in getting rid of the source of the poison by thoroughly cleansing and draining all putrid cavities with some strong antiseptic solution. All source of further introduction of poisoning being removed, the symptoms will rapidly subside. The after-treatment consists in the exhibition of tonics, especially quinine and iron.

Septicæmia is due to the introduction of an infective virus into the blood, and this virus may be in all probability introduced into the system by absorption through the mucous membrane of the respiratory or alimentary tract; still in the great majority of cases it is introduced through a wound, and it seems probable may find an entrance by either the lymphatic spaces or the blood-vessels. The virus is believed to be an infective micro-organism, for in the first place, unlike the poison causing sapræmia, it does not produce its effects immediately after its inoculation, but there is a latent period, or more correctly speaking a period during which there are no external manifestations, but during which the micro-organism is multiplying in the system. This is called the 'incubation' stage, and its duration appears to vary under different circumstances. Secondly, a very small dose, even the minute quantity which can be retained on the point of a needle, inoculated by a prick of the instrument, is sufficient to produce the most potent effects, so that in this it differs also from sapræmia—in the effects of the poison not being proportional to the dose. And thirdly, the poison is distinctly infective. If the blood of an animal that has died of septicæmia be examined, it will be found to be swarming with microbes, and if it is inoculated into another animal it produces in it the same set of symptoms. The source of the virus

Septicæ-
mia.

is, in the majority of cases, some putrid substance, and it is therefore generally inoculated with the chemical poison, sepsin. We have, therefore, *sapræmia* coexisting with *septicæmia*. When inoculated it does not always produce its effects. If, for instance, a single drop of some putrefying animal matter, not sufficient in quantity to produce any notable symptoms of *sapræmia*, is inoculated into, say, a dozen mice, as was done by Koch, in about three or four, perhaps, *septicæmia* will be established and they will die, while in the other eight or nine there will be no symptoms at all, or if there are, the animal will recover and not die. It is therefore evident that there must be a condition in the recipient of the poison favourable to its development when inoculated, or else a power on the part of the recipient which enables him to throw off or destroy the poison when not introduced in large quantities. When *septicæmia* has once been set up, the tendency is towards an increase in the symptoms, and the death of the patient, and there is not that same marked improvement to be noted, as was found in *sapræmia*, when the inoculated part is destroyed and any remains of the poison removed, so that no further formation at the seat of inoculation can take place. The symptoms of *septicæmia* may be acute or chronic. In the acute form of the disease some inflammatory changes usually take place at the seat of inoculation, often accompanied by considerable pain and sometimes attended with the formation of a little pus. Then the general symptoms are ushered in with malaise, headache, anorexia, nausea, and perhaps vomiting. Frequently a sharp rigor occurs, and the temperature rises to 103° F., or higher. These symptoms are followed by delirium. The pulse becomes weak, quick, and irregular, the breathing shallow and rapid. The urinary secretion is scanty and albuminous, and there may be diarrhœa. The patient becomes comatose, and death usually occurs about the fourth day, but may be delayed to the sixth or seventh. In the chronic form of the disease the symptoms are the same as in the acute, but less marked and less rapid in their occurrence, the duration of the disease generally being two or three weeks. In these cases a scarlet rash, resembling scarlet fever, often appears. Pneumonia or bronchitis is a frequent complication, and occasionally pleurisy or pericarditis, rapidly running on to suppuration, may supervene, and these conditions hasten the fatal termination. The morbid appearances are much the same as those found in *sapræmia*. In the acute form the blood is uncoagulated and tarry, and swarming with micro-organisms. The lungs are congested and the pleuræ and pericardium frequently studded with petechial spots. In the chronic form the spleen is frequently found considerably enlarged, and its structure soft and diffuent. The liver is often enlarged and soft, its substance fatty or presenting other degenerative changes. Sometimes the serous cavities contain blood-stained serum, or pus of a highly infective nature.

The treatment must consist, first of all, in removing the parts at the seat of inoculation or freely incising them and washing them out with a strong solution of carbolic acid, in order to prevent any more formation of poison at this part. As regards the general treatment, the chief reliance must be placed on quinine, which may be given in five-grain doses every four hours, and free stimulation, with such nutritious, easily digested food as the patient can take. Some authors recommend salicylate of soda, antipyrin, and other antipyretic treatment, such as the cold pack or cold bath. Dr. Polli of Milan some years ago published a series of experiments by which he showed that sulphurous acid in combination with potash and soda possesses

in an eminent degree the power of arresting organic fermentation, and I have certainly thought that these remedies (the sulphites of potash and soda) have been of use in cases of septicæmia.

Pyæmia, as defined above, is characterised by a remittent fever and the formation of multiple centres of suppuration in various parts of the body. There are, therefore, two distinct forms of morbid processes going on, one producing the fever, and the other the centres of suppuration. But the latter, that is to say the secondary abscesses, may occur without the former, and we have then a form of pyæmia without any true infective process to which the febrile disturbance and other constitutional symptoms are due. The constitutional condition, like septicæmia, is due to the inoculation of some infecting virus, and this is probably a micro-organism. The local condition is supposed to be brought about in the following manner. Almost invariably in pyæmia there is a wound in a state of suppuration, and in the majority of cases this wound is in a putrefying condition. Under these circumstances the vessels in the neighbourhood, and especially the veins, are filled with coagula. These coagula, probably under the influence of the infecting organisms, become broken down, and small pieces of detached blood-clot are carried into the blood-stream, along which they pass until, in the course of the circulation, they reach some vessel which is not sufficiently large to admit of their passage, and there they become arrested and form an embolus, the nidus of a secondary abscess. In this way is explained the frequent occurrence of secondary abscesses in the lungs, where the suppurating wound involves some part in which the systemic veins are involved, and the liver when the veins of the portal circulation are implicated. It has been proved by experiment that when small *non-irritating* solid particles are injected into the blood-stream they form emboli in the small vessels and produce what are known as 'hæmorrhagic infarcts.' Supposing some fluid holding in suspension some small particles is injected into a systemic vein, they will become lodged in a small artery of the lung. The part supplied by this small branch will become intensely congested, the vessels will give way and extravasation take place, and the portion of lung will become of a dark purple, almost black, colour and quite solid. This is an hæmorrhagic infarct. If the solid particle is non-irritating this will be absorbed without suppuration; but if on the other hand it is irritating, suppuration will be set up and an abscess formed. In pyæmia the small broken-down pieces of clot which form the embolism are irritating, and in the majority of cases infective, and contain the specific micro-organism, and thus may themselves become the seat of fresh infective processes, and may be one means of accounting for secondary abscesses in other situations than the first set of small arteries or capillaries which would be reached in the course of the clot from the original wound. The fact that secondary abscesses may occur in distant parts and in other organs beyond the first set of capillaries in the course of the circulation from the original centre of infection has always been a difficulty in explaining the causation of these pyæmic abscesses by this mechanical theory, and has induced some authors to believe that this can only be one of the agencies in giving rise to secondary abscesses in pyæmia. Weber has endeavoured to explain it by stating that very fine particles may pass through the first set of capillaries, viz., those generally of the lungs, and may give rise to embolism in those of the systemic circulation. The observation that irritating but non-infective emboli give rise to suppuration in hæmorrhagic infarcts may serve to explain those cases where we get

secondary pyæmic abscesses, without the infective fever. Here there are no micro-organisms in the blood, and, therefore, the pieces of clot detached from the broken down thrombus and carried in the circulation form irritating emboli in the lungs, and so pyæmic abscesses, but there being no infective organisms there are no general constitutional symptoms.

Symptoms.

The accession of pyæmia is usually marked by very definite symptoms of fever—rigors, recurring at intervals sometimes so regular as to be mistaken for ague, and usually followed by colliquative perspirations; bilious aspect of the countenance, the so-called pyæmic jaundice,¹ frequent and small pulse, and numerous other symptoms, varying with the part on which the stress of the disease falls. Thus, when the circulation of the brain is affected, there may be delirium; of the intestines, diarrhœa; of the lungs, dyspnœa, and so on; but very commonly the recurring rigors and the consecutive perspirations, marking a persisting fever for which there is no explanation in the local conditions, are the only prominent symptoms. The local conditions, indeed, as shown by the state of the wound, are often indistinguishable from those of an ordinary healing ulcer, though there are no doubt cases in which the granulations turn grey and wither and the discharge becomes ichorous. The state of the tongue is also very variable. But the persistence of a considerable amount of fever from day to day, such as is shown in the accompanying thermograph, after a wound or injury, is always suspicious, and usually indicates the absorption of poisonous matter into the blood. In fact, unless there is some specific affection, or some evidence of deep-seated suppuration, it is difficult to explain the occurrence of this fever otherwise. A comparison of the thermometric chart on this

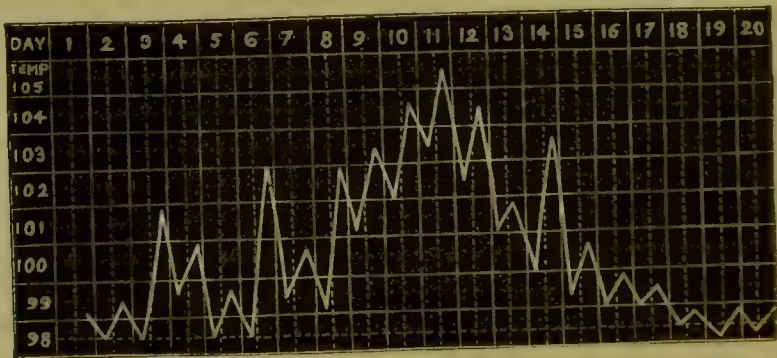


FIG. 8. Thermograph of Pyæmia terminating in recovery. The first rigor which was observed took place on the 8th day.

Tempera-
ture in
pyæmia.

page with those of simple traumatic fever (on p. 28) and of hectic (on p. 52) will show the following differences. In traumatic fever, which depends on the application of a definite 'stimulus' to the blood, whereby its heat is raised above the normal, there is a more or less abrupt rise so long as this stimulus acts until the climax is reached, when it is succeeded by a gradual defervescence, and the temperature comes back to the normal, and so remains. In hectic there is a recurrence of the feverish condition regularly once or twice a day, quickly followed by sweating and a fall to the normal temperature. In pyæmia there is a constant exaltation of the natural temperature, but with irregular exacerbations (at the times of

¹ This yellow tinge of the surface in pyæmia is not usually so marked or so universal as in true jaundice. When the latter symptom is well marked there is reason to suspect secondary deposit in the liver—though this is not always found—sometimes only inflammatory softening. See Billroth, 'New Syd. Soc.'s Transl.' ii. 53.

the rigors), the temperature, however, remaining above the normal all the time.

The local suppurations come on at most irregular periods, and affect the most various organs. There is probably no organ of the body which is not sometimes attacked by the pyæmic inflammation, though the lungs, liver, and joints are those most commonly implicated. The symptoms caused by these local inflammations are often very slight. Dyspnœa may be present to a less or greater extent when the pleural cavity or lung is inflamed, pain under the ribs or jaundice in affection of the liver, pain and redness in the neighbourhood of affected joints; but such symptoms are usually much slighter than in healthy inflammations, and pyæmic abscess is constantly found after death in organs where there has been no reason to suspect it during life.

Pyæmia is apt to follow almost every injury to which the body is exposed, and every disease by which decomposing substances can be presented to absorbing surfaces. But there is no doubt that it is caused in the great majority of cases by injuries in which the vessels of bone are laid open, and exposed to the contact of inflammatory products, and by such injuries or diseases as affect the main veins. Thus compound fractures, excisions, and amputations (which may be regarded as kinds of compound fracture), severe contusions and contused wounds producing thrombosis of large veins, parturition which exposes the great venous channels of the uterus to the contact of decomposing matter, erysipelas, diffuse inflammation, phagedæna, diffuse or acute periostitis, and acute inflammation of the interior of bones, are among the most frequent exciting causes of this affection.

Causes of
pyæmia.

The diagnosis of pyæmia is not by any means easy in all cases, or even sometimes possible at first. It must depend mainly on the indefinite course of the fever and the recurring rigors. The temperature maintains itself above the normal, and is exacerbated from time to time when the rigors take place, falling again as the sweating goes on. By this course of the temperature and by the recurring rigors and sweats we diagnose pyæmia previous to the occurrence of visible deposits or internal inflammations, recognisable by their symptoms.

Diagnosis
of pyæmia.

The prognosis of pyæmia is, as a general rule, very bad; that recovery does ensue, however, we have the most ample proof, and it appears to occur more frequently in cases of pyæmia following parturition than in those having their origin in an open wound, and is always the more probable the more chronic is the course of the symptoms.

Prognosis.

The treatment of pyæmia really resolves itself into prophylaxis. Pure air, with avoidance of overcrowding; perfect cleanliness on the part of the patient and his surroundings as well as regards the wounds and the appliances used in its dressing; free drainage and careful antisepticism will do much to banish pyæmia from the category of diseases. When it has once set in, little can be done. None of the various plans of specific treatment which have been proposed, as by quinine, mercury, alcohol, or opium, appears to exert the least real influence on the disease itself. All that can be done is to support the patient's strength, and treat the symptoms as they occur. When abscess forms in an accessible situation it should be opened with the most rigid antiseptic precautions.

Treatment.

The above description applies to acute pyæmia as we ordinarily see it, especially in surgical practice, as occurring after severe injuries, particularly those in which bones are involved. It is an acute disease, and its course is

Chronic
Pyæmia.

usually to be reckoned by days, rarely extending to some weeks. But pyæmia occurs also in a chronic form, of which Sir J. Paget has given, in the paper which commences the first volume of the 'St. Bartholomew's Hospital Reports,' an excellent description, and some very striking instances, in one of which the symptoms were protracted over three years. The essential features of this form are similar to those of acute pyæmia, and with proper attention the diagnosis can usually be established; but the resemblance both to rheumatism and to hectic fever is much greater than in the acute disease, especially to hectic, which in fact may supervene. The disease is not so dangerous as the acute affection, and it is frequently spontaneous, or at least independent of any traumatic cause. Sir J. Paget has noticed that 'the local evidences of chronic are more frequently than those of acute pyæmia seated exclusively or chiefly in different parts of the same tissues [as, for instance, if occurring as a consequence of disease of a bone, all the secondary inflammations may affect the osseous system only]; that they are more frequent in the trunk and limbs than in internal organs, and when seated in the veins are most frequently found towards the close of the disease.' And he adds a most important practical point, in which chronic pyæmia agrees with hectic, viz., that in this, as in hectic, the removal by operation of the seat of the original disease is frequently so beneficial that it becomes the surgeon's duty to perform the operation, whilst in the acute stage of pyæmia operations almost always deprive the patient of the faint chance of life he might otherwise have.

Hectic
fever.

Clearly distinguished from the previous forms of fever, which all run a definite course, is the feverish condition called 'hectic' or 'suppurative' fever,¹ which runs no definite course, and tends to death by exhaustion. It is generally caused by profuse and long-continued suppuration, but may be occasioned by anything which causes a greater expenditure of the elements of nutrition than can be supplied to the blood.

Its symptoms are arranged, for convenience of description, into three stages, between which, however, there is no exact separation:—

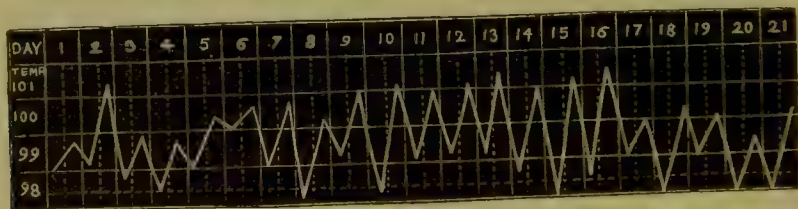


FIG. 9. Thermograph of Hectic Fever. From a case of pelvic inflammation after parturition, which ultimately ended in recovery.

In the first stage there is loss of flesh, varying and feeble pulse, the skin is dry and becomes hot towards evening, when the patient feels chilly, and the general temperature rises; there are profuse night-sweats with morning remissions; the tongue is clean and red.

In the second stage the emaciation is greater, the hectic flush begins to appear (that is to say, a circumscribed red blush on the cheek strongly contrasted with the clear pallor of the complexion, and lasting so long as the hot state continues), the night-sweats are much more profuse—'colliquative,' as they are termed—and there is often diarrhœa; the rise of temperature at night is more marked to the thermometer; 'the urine after the sweating

¹ Billroth has applied the term 'suppurative fever' also to pyæmia.

will be found to contain increased quantities of urea,¹ chloride of sodium, sulphuric acid, and water.' (Croft.)

The third stage is one of still more marked exhaustion and failing powers; the pulse feebler and more rapid, the skin dry and scaling, the motions loose and sometimes passed involuntarily, the urine offensive, the mouth aphthous; the chills and sweats are more frequent, occurring sometimes twice in the twenty-four hours; the legs become œdematous, bed-sores are apt to form. In some cases consciousness gradually departs before death. The patient dies very gradually, almost imperceptibly.

This condition differs entirely from traumatic fever, since it does not depend on any definite irritation, and runs no definite course; and from pyæmia in the same particulars, and also in the absence of any imbibition of poisonous materials by the blood.

The treatment of hectic must generally be directed merely to keeping the patient alive, in the hope that the source of suppuration will dry up, and on the cessation of the cause the hectic fever will subside. But there are a few cases, mainly those of suppurating joints and bones of the limbs, in which the source of suppuration can be removed by operation, and if this is to be done, it should always be done as early as possible in the disease. At later stages the patient is too weak to bear the shock of an operation. In the majority of cases where the source of this disease cannot be removed (of which the hectic ensuing on psoas abscess is a familiar example) the patient's strength must be supported, and albuminous materials supplied to the blood while the disease is passing over. Small quantities of nourishing food, wine or beer, repeated as often as the patient can bear it without making too strong calls on his digestion, quinine, sulphuric acid, and iron to check the feverish exacerbations and the sweats, and opium to stop the diarrhœa and procure sleep, are the chief indications of treatment.

Long-continued suppuration may also prove fatal by inducing disease of the abdominal viscera, chiefly the kidneys, liver, and spleen. It is now universally admitted that the condition which was originally described as 'waxy,' or 'lardaceous' disease of these viscera, and afterwards, not very correctly, as 'amyloid degeneration,' is often caused by long-continued suppuration, and this degeneration of the liver and kidneys is a frequent cause of dropsy and thereby of death in patients labouring under exhausting suppuration, whether with or without hectic fever. Dr. Dickinson, to whom we owe, I believe, our first accurate statement of the cause of this degeneration,² traces its production to the great loss of the alkaline salts of potash and soda from the blood in order to form pus. He points out that the alkalinity of pus is due to its containing about twice the quantity of the salts of potash and soda which are contained in the serum of blood; that the waxy or lardaceous viscera always contain a decidedly smaller quantity of such salts than are contained in the healthy viscera, and that the so-called 'amyloid' reaction may be artificially manufactured by depriving fibrine of the alkali with which it is naturally combined. From which he concludes that the loss of alkali from the blood, through long-continued suppuration, disposes to the deposit

Suppurative degeneration of viscera.

¹ In all these fevers [i.e. in all traumatic and suppurative fevers] the quantity of urea is always greatly increased, and generally exceeds the quantity of nitrogen contained in the food. At the same time the weight of the body decreases considerably. Billroth, ii. 40.

² 'Med.-Chir. Trans.' vol. l. p. 39.

around the minute vessels in the affected organ of the substance displaying this so-called 'amyloid reaction.' At any rate, I think the fact is now certain that long-continued suppuration does produce such waxy degeneration, and in this way may indirectly cause death—an additional motive for ridding the patient of the source of incurable suppuration, whenever that is possible.

Erysipelas.

The term *erysipelas* is applied to a spreading inflammation of the skin, mucous membrane, or connective tissue beneath them; and the disease is divided into two chief varieties—simple or cutaneous erysipelas, in which only the skin or mucous membrane is implicated, and phlegmonous erysipelas or diffuse inflammation, in which the connective tissue is the part mainly involved. Some writers also describe a third variety—diffuse cellulitis—in cases where the integument is not inflamed at all; for instance, the diffuse inflammation of the pelvic cellular tissue which sometimes follows surgical operations.

Erythema.

Erythema is an affection having much resemblance to erysipelas, but differing from it in the fact that in erythema there is no necessary constitutional complication, and that the redness of erythema is not accompanied by any definite sign of inflammatory exudation, which is always the case in erysipelas.

Erythema is usually a mere local affection, and might perhaps be appropriately enumerated amongst the skin-diseases; but as it is advisable for purposes of diagnosis to state its distinctive features in this place, I will here mention its chief varieties and their treatment. Erythema is defined as a superficial redness, from injection of the capillary vessels of the skin. As in erysipelas, the redness disappears on pressure, and in some cases it is accompanied by a little thickening of the tissues of the skin. In some forms of erythema, however, this thickening or œdema is the cause and not the consequence of the injection; the latter, in fact, is due to passive and not to active congestion. Such is the case in the *E. læve* or *œdematosum*, the redness of œdematous skin; and this is to be remedied mainly by position, the removal of any cause of obstruction, warm astringent lotions, and the cautious and dexterous application of pressure. *E. intertrigo* is somewhat allied to this; it is the redness which attacks the surface where large folds of skin and fat rub against each other, as in the pendulous bellies of very fat people, or in the groins of infants. The scorch of a sunburn or other irritant is somewhat of the same kind. Cleanliness, the avoidance of friction, powdering the part, and brushing it with nitrate of silver lotion or some other astringent, will relieve it.

Erythema læve and intertrigo.

Erythema fugax.

There are many other forms of erythema which, though they are in themselves local, yet own a general cause. The most obvious and familiar instance of this is the 'chloroform or ether-rash,' which is so often seen on the chest and other parts in young people of delicate skin—a slight erythematous eruption which very quickly fades away. The late Dr. Murray observed often a swollen condition of the thyroid gland during its appearance. This of course requires no treatment. In other cases erythema fugax appears as a consequence of indigestion, especially from eating shell-fish or pork, in persons to whom such food acts in a poisonous manner, or as a complication of various diseases in which the digestive system is disturbed. The knowledge of the cause points out the treatment.

Erythema circinatum, mar-

There are other special forms of erythema which are more persistent, and which more nearly approach the characters of the definite skin-eruptions,

especially roseola. Such are the *Erythema circinatum* and *marginatum*,—definite rings, patches, or spots of redness, very hardly if at all distinguished from roseola when occurring in a similar form; *Erythema papulatum*, in which the spots are raised up into a sort of pimple; *Erythema tuberculatum*, in which the prominence of the spots is greater, and in which they are more persistent. This form is usually seen as a symptom in the debility of fevers. It forms the transition to the *Erythema nodosum*, which is not uncommon as a substantive disease.

*ginatum,
papulatum
and tuber-
culatum.*

Erythema nodosum differs so much from the usual forms of erythema that it is doubtful whether it ought to be included among them or classed with affections of the lymphatic system. It occurs in the form of raised patches or tubercles of a red or reddish-yellow colour, and somewhat tender to the touch, sometimes accompanied with a good deal of smarting pain. The patches are generally about the size of half a nut, sometimes as large as the fist. They are seated most commonly on the legs, but they may affect any other part; and Hebra speaks of cases in which as they disappear at one part they occur at another till the whole body has been implicated. They never suppurate, and the redness of the individual tubercles never spreads to the skin around them, a character which is peculiarly distinctive of *erythema nodosum*. 'It is very probable,' says Hebra,¹ 'that in its pathological anatomy *E. nodosum* is allied to absorbent inflammation, and likewise to the erysipelatous diseases,² and the same thing may perhaps be said also of the other erythemata. Indeed, it admits of no doubt whatever that the morbid process concerned in some cases of *Erythema nodosum* is essentially an inflammation of the lymphatic vessels.' The disease more often affects young women suffering from menstrual irregularities than any other class of persons, though men suffer from it also, and children sometimes.³ It is usually connected with some obvious disturbance of health, and may be accompanied with more or less symptomatic fever. The treatment consists in the restoration of the general health, and in alleviating the pain by position and by mild soothing warm applications.

*Erythema
nodosum.*

We must now turn to the varieties of erysipelas, which are distinguished from these various forms of erythema both by the local characters of the eruption and by the presence of a definite form of general fever.

The *cutaneous* or simple erysipelas is a spreading inflammation of the surface of the skin, with thickening of its tissue, and sometimes considerable puffiness of the subcutaneous parts. The puffiness is especially marked in erysipelas of the face, where the features swell so much and so rapidly that the patient is quite irreconisable in a few hours, and loses all power of vision from the swelling of his eyelids. The redness of erysipelas is usually of a bright tint, often mottled, disappearing on pressure; it has a definite border, which, however, shifts continually as the eruption advances or recedes, and the surface, especially on the face, is often studded with vesicles or blebs. There is often a good deal of tingling pain in the part, and swelling of the absorbent glands is a very common phenomenon. In fact, the glands have often been found enlarged before the eruption shows itself; and if these enlarged glands be more carefully examined, tenderness will often be detected in the course

*Cutaneous
erysipelas.*

¹ 'Diseases of the Skin,' translated for the New Syd. Soc., vol. i. p. 291.

² We shall see presently how close is the connection between erysipelas and inflammation of the absorbents.

³ Cases of this disease in childhood will be found related by Dr. Goodhart, 'Guy's Hospital Reports,' vol. xv.

of the lymphatics which lead to them. These symptoms are only the local manifestations of a general disorder of the system, as shown by the fever which accompanies them. There is almost always a rigor, often several, at the commencement of an erysipelatous attack; the tongue is usually coated and often dry, the pulse rapid, the patient restless and feverish, appetite bad, bowels constipated, urine high-coloured and often slightly albuminous.

The rise in temperature, as seen in the annexed thermograph, is often very abrupt,¹ and the defervescence frequently as rapid. The course of the temperature in uncomplicated erysipelas (such as is shown in the chart) differs from that in traumatic fever in running a much less regular course, and usually subsiding more rapidly and abruptly; and from that in pyæmia, in not presenting those constant exacerbations and depressions which mark the rigors and sweats of pyæmia. But erysipelas so frequently supervenes on traumatic fever, and is so frequently complicated with local and general disturbances (notably with the formation of abscess and with the transition to pyæmia), that its temperature-curves vary very considerably.

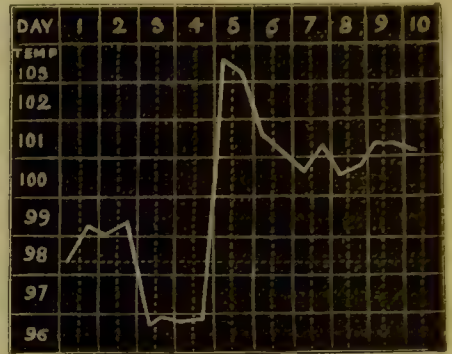


FIG. 10. Thermograph of Erysipelas.

There is an interval between the first feverish symptoms and the appearance of the rash which is said sometimes to be as long as four days, but which I think is rarely more than twenty-four hours. The fever ought to subside considerably in a few days. If the pulse and temperature keep up beyond about ten days, and particularly if there is a rapid and considerable rise after a week, the case may be expected to terminate fatally, though I have seen exceptions to this rule. Disturbances of digestion are very common in erysipelas, so that sometimes the rash is mixed more or less with the colour of bile, and the conjunctivæ are slightly jaundiced, and this is sometimes described as 'bilious erysipelas,' though it hardly seems to require a separate name. Conversely, bilious disturbance is occasionally an exciting cause of erysipelas, so that persons predisposed are very liable to have an attack of erysipelas from disturbance of the liver. Erysipelas lasts an uncertain time, generally fading gradually and disappearing with desquamation of the epidermis; but sometimes vanishing suddenly in one part of the body to appear in another—*erratic* erysipelas. Suppuration often follows in the cellular tissue, or in the glands which were originally inflamed. There are, again, cases in which no preliminary affection of the lymphatics or of the glands precedes the attack of erysipelas, but in which the erysipelas itself originates the inflammation of the absorbents. In fact, the connection between spreading erysipelatous inflammation of the skin and the similar inflammation of the absorbents is, as might have been anticipated, an extremely close one; and this illustrates what was said above of the close connection between erythema nodosum, erysipelas, and absorbent inflammation. As the case progresses the constipation often passes into diarrhœa, the feverishness gives way to lassitude and exhaustion, and death by asthenia is threatened.

Kinds of cutaneous erysipelas.—Numerous varieties have been described

¹ The fever and the rise of temperature, though common, are not absolutely constant symptoms of erysipelas. My colleague, Dr. Cavafy, has published ('Brit. Med. Journ.' March 29, 1884) an interesting series of cases of facial erysipelas with low temperature.

by authors, more indeed than there is any practical necessity for distinguishing. I see no object in describing as distinct varieties more than the *E. ambulans*, in which the rash spreads rapidly over the greater part of the whole body; the *E. erraticum*, in which it leaves one part to appear in another; and the *E. metastaticum*, in which, after the subsidence of erysipelas of the skin, an affection, presumed to be of an erysipelalous nature, is developed in internal organs, which, however, is certainly very rare, if indeed it has any existence apart from general blood-poisoning.

In *phlegmonous erysipelas* the skin is less, and the subjacent cellular tissue much more, affected than in the simple cutaneous form, not that in the latter the cellular tissue is usually quite unaffected, as the swollen features of erysipelas of the face show. The general symptoms of phlegmonous erysipelas or 'Diffuse inflammation' are much the same as those of cutaneous erysipelas, but more intense; the redness is usually deeper in colour, the skin more brawny, and the part is œdematous and sometimes very tense. In a few days it becomes boggy, from the formation of matter. This is often accompanied by renewed rigors, and the skin frequently sloughs, sometimes to a very great extent. Thus I have seen the whole scalp perish, exposing the entire vertex of the cranium, in a case of diffuse inflammation of the head. The destruction from suppuration and sloughing often extends very deeply and very far, opening into the joints, destroying muscles, exposing bones, &c.

Phlegmonous erysipelas or diffuse cellular inflammation.

Diffuse cellulitis is a variety of this in which the skin is almost or entirely exempt, or which attacks the cellular tissue in a part where there is no skin. In some forms, especially in those rapidly fatal cases which have been known to follow dissection-wounds, the disease evidently has a very close relationship to pyæmia, and the rapid occurrence of death shows that the general mass of the blood is affected. In such cases it does not necessarily spread from the wound, but appears at a remote part of the limb, or even on the opposite side of the body. And in other cases diffuse cellulitis accompanies or precedes traumatic gangrene, the limb being mottled with patches of a dark red colour, which, when cut into (in amputation, for example), are seen to consist of patches of cellular tissue loaded with serum and a dark-coloured sanious lymph. The inflamed cellular tissue in such cases rapidly sloughs, involving the skin in its destruction.

The investigations and experiments of Fehleisen would appear conclusively to prove that the exciting cause of erysipelas is the introduction into the blood of a microbe. Many observers have, previously to the investigations of Fehleisen, asserted that they have found micro-organisms in the blood and tissues of patients suffering from erysipelas, but Fehleisen succeeded in isolating and cultivating them and in successfully inoculating them both in man and the lower animals. He succeeded in breeding the 'micrococcus pathogenicus,' which he believed to be the erysipelas microbe, to the fourteenth generation by cultivation of some small pieces of skin in pepton-gelatine, and then inoculated them into a number of rabbits. In every instance but one, he succeeded in producing the characteristic erysipelalous rash, which ran a definite course. Not content with these results Fehleisen next proceeded to inoculate them into some of his patients, on the principle that an attack of erysipelas has sometimes a beneficial influence on certain cases. Thus he inoculated a patient suffering from multiple fibro-sarcomatous tumours, another with lupus, and a third with recurrent cancer of the breast. In all of these he produced a distinct erysipelalous attack, so that he appears clearly to have proved that there is a micrococcus which is intimately connected

Causes of erysipelas.

with the causation of erysipelas. The microbe is most commonly admitted through a wound, and is probably introduced through the lymphatic system. This explains the close connection, which has been alluded to above, between erysipelas and absorbent inflammation.

The predisposing causes of erysipelas are twofold; first, anything which depresses the vital powers of the patient, and, secondly, bad air and faulty hygienic conditions. Habitual intemperance, insufficient or improper diet, visceral disease, especially disease of the kidney, produce a condition of the system in which organisms, if introduced, appear to flourish, whereas the healthy body seems to have the power of destroying or throwing off micro-organisms, if not admitted in excessive numbers. In addition, many people, without any such definite predisposing cause, have a constitutional predisposition to erysipelas (particularly of the head and face), which will show itself in them on the slightest exposure to the exciting cause.

Diagnosis
and
prognosis.

The *diagnosis* of the disease is usually obvious. In some few cases there may be a little difficulty in distinguishing diffuse inflammation from phlebitis or from inflamed absorbents, and I have seen a more fatal error committed in treating a case of deep-seated abscess below the fascia, accompanied by œdema and inflammation of the cellular tissue above it, as one of diffuse inflammation merely. The patient died, with numerous incisions into the subcutaneous tissue, but with the abscess unopened below; and I have seen the same error committed with less serious results, as the diagnosis has been corrected afterwards. When any reason exists for believing that matter is situated below the fascia, an exploratory puncture should not be neglected.

The *prognosis* of the disease depends on a great number of different considerations. *Cæteris paribus*, the different forms of erysipelas are dangerous in proportion as they are deep-seated—the cutaneous, cellulo-cutaneous, and cellular in that order. But the prognosis varies also with the condition of the patient, being bad in the intemperate and bloated, and especially in those with diseased kidneys or liver; with the patient's age, being bad in the aged and in the *very* young, though good in childhood; with the exciting cause, being worse in epidemics; with the form of the disease, being worse in erratic erysipelas and in recurrent attacks; with its course, being worse when the disease does not subside at the usual period, and particularly if the fever is lighted up again after partial subsidence about the first week; with the situation, being worse in erysipelas of the head and face, and peculiarly so in diffuse inflammation of the neck, and especially if in either case the erysipelas spreads internally to the mouth and fauces. These are the main prognostic considerations, though many others might be added. And it should not be omitted that erysipelas is sometimes salutary, ushering in a better state of health, and preceding the definite healing of wounds and ulcers which had long been open and sluggish.

Treatment.

The *treatment* of erysipelas resolves itself naturally into *general* and *local*. The former is the same for all forms of the disease, and is regulated by the general symptoms present in each particular case, i.e. it consists in the treatment of the accompanying fever. In the present day the old antiphlogistic or depletory treatment of fever has been practically abandoned; yet there are cases of erysipelas in which, if I can trust my own observation, the indiscriminately stimulant treatment (which has so generally superseded that of indiscriminate depletion) is very ill-borne, and has a direct influence in prolonging the disease. The strength of the pulse, the general appearance of

the patient, and his apparent vital power must guide the surgeon. In the plethoric and strong, after the bowels have been freely evacuated with a mercurial purge (which should be done in every case of erysipelas, even when diarrhœa is present, for the diarrhœa often depends on loaded bowels), salines and light fluid diet without stimulants should be ordered. But there are very few cases (if any) which will not be benefited by the administration of wine or beer carefully at some period of the attack; and if there are any which require bleeding or leeching at first, I have not met with them, although I am prepared to admit the advisability of taking blood either from the arm, or better from the temples by leeches, in cases of erysipelas of the head accompanied by sthenic inflammation of the membranes of the brain. In almost all the cases of diffuse inflammation (cellulo-cutaneous) which we see after injuries, no judicious practitioner can hesitate as to the desirability of at any rate avoiding depletion, and a resort to free stimulation is generally followed by amendment. The diet must be regulated by the state of the appetite and tongue. It can do nothing but harm to load a man's stomach with food which he cannot digest, but when meat and other nourishing diet can be borne it should be given along with the stimulants. The kind and quantity of the latter must depend on the patient's previous habits to some extent, but nothing seems in general more grateful to the patient and more supporting than good porter. When there is much nervous excitement and restlessness opium should be carefully administered; but as a rule opiates are to be avoided in erysipelas, except in the phlegmonous form after injuries. Camphor, ammonia, and light tonics are generally well borne after the bowels have been regulated. Iron, particularly in the form of the Tinct. Ferri Perchloridi, is believed by some surgeons to have a direct influence on the blood, and thus to act as a specific on the disease. The idea depends on an assumed condition of the blood in life something similar to, if not identical with, the state in which the blood is found after death. There is no doubt that in many post-mortem examinations of persons dying with erysipelas nothing abnormal has been found except a thick, tarry, uncoagulated condition of the blood, staining the vessels, soon putrefying, and leading to a diffuent condition of the spleen and other viscera which contain much blood. On microscopic examination of the blood the corpuscles are found irregular and broken. It is assumed with great probability that this testifies to a previous disorganisation of the blood during life. And it may be that iron, if it can be assimilated, will correct this; and certainly the free exhibition of iron is believed by some to be very beneficial in many cases. But then it must be given very freely (say xv.-xx. drops every three hours) in order to produce any such specific effect. And it will not agree with the patient if given when the tongue is foul and the general fever is rising. When iron has been prescribed in such cases I have often seen marked benefit from discontinuing it, and prescribing salines, with small doses of antimony, if the strength admits of the latter drug being borne; or if there is much prostration, combined with tincture of bark and ammonia. Dr. Ringer believes that aconite will cut short an attack of erysipelas if given directly the temperature begins to rise. He recommends that it should be given in minim or half-minim doses of the tincture every quarter of an hour for six or eight doses, and then hourly until the temperature falls and the skin becomes moist.

The local treatment differs according to the form of the disease. In the cutaneous form the exclusion of the air is often very soothing. Thus in erysipelas of the face a mask is made for the patient, smeared with some oint-

ment (a favourite one for the purpose at St. George's Hospital is an equal mixture of Ung. Plumbi and Ung. Calaminæ), or the part is defended with a layer of cotton-wool, or some bland warm lotion is used, such as Lotio Plumbi, a lotion of sulphate of iron ʒj. to Oj., or of the Tinct. Ferri Perchlor. ʒij. to ʒviij. of water. Diluted tincture of iodine is recommended by some. Nitrate of silver in a strong solution (about grs. xv. to the oz.) appears to me often very useful; and many surgeons are fond of drawing a ring round the erysipelatous rash, or round the limb above it, with a stick of caustic, a practice to which there is certainly no objection, but which appears to be of very doubtful utility.

In diffuse inflammation and in cellulitis more decisive measures are necessary. In the early stage, when there is only a little œdema around the wound, the discharge of inflammatory products is to be insured by laying the wound freely open with the finger or director. If, notwithstanding this, the inflammation spreads and the tension increases, it becomes a question whether or no incisions should be made, not in order to evacuate matter—for as yet no matter will have been formed—but to relieve the tension of the parts, and to avert the gangrene which is threatened, as well as to provide free exit for the matter when it does form. For there can be no doubt that the pressure caused by exudation of serum and lymph on the capillaries which pass through the cellular tissue, and the stretching of these vessels as the skin is pushed away from the fascia, are potent causes of gangrene. When, therefore, the local symptoms are marked enough in the surgeon's judgment to require such severe measures, incisions ought to be made freely and boldly into the cellular tissue. Each incision should be of no great length (say two or three inches), but they should together embrace the whole extent of the tense parts; and if the tension affects fresh parts afterwards they should be repeated. A good proof of their necessity, and a good augury for their beneficial influence, is the free gaping of each cut as it is made. If any considerable vessel is wounded it must be secured either by torsion or ligature, but a certain amount of bleeding is rather to be encouraged. If the hæmorrhage is alarming, but its source cannot be detected, in consequence of the cut vessel having retracted into the œdematous tissue, the bleeding can be repressed by stuffing the wound with lint for a few hours and making pressure over it. After four or six hours this may be withdrawn without fear of renewed bleeding.

In cases not severe enough to demand incision the parts should be relaxed with hot boracic lotion. Many surgeons speak favourably of the apparently less severe measure of multiple punctures with a lancet as a substitute for incisions, but they generally give a good deal of pain, and are insufficient to afford relief.

In making the incisions it is often advisable to administer an anæsthetic, more especially in view of the very probable necessity of the repetition of the operation; and if the same indications call for it, no hesitation should be felt in repeating the incisions again and again. I have often seen a case terminate happily with a dozen or more incisions, embracing every part of the limb, and have often seen occasion to regret that incisions had not been made freely enough, where the patient has either sunk under the irritation of constantly advancing erysipelas, or has recovered, but with much loss of function of the limb, from sloughing of skin, fascia, or tendons. In cases where this has unluckily occurred, leading to stiffness and loss of motion of the joints, and particularly the fingers, careful and diligent passive motion after the wounds

are healed will often be rewarded with great success. The part should be well steamed, and each of the affected joints severally attended to, by gentle, cautious, and gradually increasing passive motion, while the patient is encouraged to use the part as much as he can, without great pain or subsequent swelling. Many unfortunate cases are sent into hospitals, in which the limb has been so disintegrated by the sloughing caused by neglected phlegmonous erysipelas that amputation is the only remedy.

By *gangrene* is understood the death of a visible portion of the soft parts, and its removal in a mass, which is called a *slough*. The terms *sphacelus* and *mortification* are also sometimes used to express the process of gangrene.¹ Gangrene.

Gangrene may be the result of mere spontaneous inflammation, but as a general rule this is not so. The great majority of the cases which we see in practice own some definite cause, although in most of them inflammation has played an important part in completing the death of the tissues.

Gangrene is divided (*a*), according to its exciting causes, into traumatic and spontaneous, and (*b*), according to its form, into moist and dry. Traumatic and spontaneous gangrene.

The usual causes which produce traumatic gangrene are mechanical injuries, chemical injuries, local poisons, heat or cold, and arrest of circulation.

The first cause is too familiar to need any illustration. Of chemical injuries, the ordinary caustic issue is a common example, where the skin is destroyed by the desiccating action of the potassa fusa, and is cast off as a slough, the result being a healthy, granulating ulcer. Closely analogous to such cases are those which result from the local action of poisons, such as putrefying urine. Such urine escaping through a ruptured urethra kills the cellular tissue into which it is extravasated, producing secondarily the death of the skin which receives its nutrition through this cellular tissue. Gangrene from burns is unhappily too common, and that from frostbite is tolerably familiar to most surgeons. Gangrene from arrest of circulation may arise from obliteration of the main artery at one spot, as when the femoral is tied, or from general pressure, as when the skin is destroyed by tight bandaging. Spontaneous gangrene occurs sometimes as the direct result of specific inflammation, as the sloughing which follows a boil or carbuncle²; or it may be caused by degeneration of the vessels in old age (senile gangrene), by impaction of a plug of fibrine in a large vessel (gangrene from embolism), by inflammation of arteries leading to their obliteration, by loss of nervous power, and by impaired nutrition. The sloughing of the cornea which follows on injury of the fifth nerve is usually quoted as an illustration of gangrene produced by loss of nervous power, and the gangrene which used to be produced by eating cock-spurred rye, of gangrene from impaired nutrition; but the two causes seem identical, for loss of nervous power appears to produce gangrene merely by impairing nutrition of the part. Gangrene is peculiarly liable to occur after slight injuries, or other causes of inflammation, in diabetic

¹ '*Gangrene* properly signifies the state which immediately precedes mortification, while the complete mortification, or absolute death, of a part is called *sphacelus*.'—Hooper's Med. Dict. But the distinction is not a very obvious one, and the term *sphacelus* is superfluous, and is now almost disused. When mortification is spoken of as distinct from gangrene, the former means the process, the latter the result.

² Many other forms of gangrene are probably due to specific causes, such as noma and cancrum oris, malignant pustule, glanders, spreading traumatic gangrene and hospital gangrene.

patients. A peculiar form of spontaneous gangrene has been described by Raynaud, under the name of 'La gangrène symétrique des extrémités.' As its name implies, it comes on symmetrically in two extremities. Its cause is unknown, but it occurs generally in people who suffer from cold extremities and chilblains, and appears to be due to a deficient supply of blood to the part.

We see, then, one main distinction between the two classes of cases, which is of the highest importance in their surgical treatment, viz. that the causes of the former are local, and, therefore, often susceptible of mechanical removal; while those of the latter are mostly general; so that even if the affected part of the body could be removed without any injury to the patient, the same general cause would in all probability reproduce the gangrene elsewhere.

Moist and
dry gan-
grene.

The division of gangrene into moist or dry is a classical, and in the extreme cases a very well marked one, but in ordinary instances it is not very easy to refer the case to one or the other form. The best examples of dry gangrene are sometimes seen in the fingers or toes of very old persons, where the arteries become entirely impervious, the part turns dry and white (sometimes yellow or brown or black), shrivels up with little pain or inflammation, and thus separates from the body.¹ The purely inflammatory forms of gangrene, on the other hand, are always moist; much fluid and much gas, the result of putrefaction, are effused into the cellular tissue, and the affection is accompanied usually by a great deal of pain. So that it is clear enough that gangrene depends in the former class of cases on deficient supply, and in the latter on obstructed return of blood. But in most cases the two causes act together. Thus, in senile gangrene the main cause is indisputably the deficient supply of blood, and it is, therefore, usually classed as a form of dry gangrene; yet obstruction of the capillary and venous circulation also plays a prominent part, and in many cases there is the inflammatory pain, and the loading of the part with the products of inflammation, which are characteristic of moist gangrene.

Pheno-
mena of
gangrene.

Taking an ordinary example of gangrene, in which the part has been previously inflamed, its red colour becomes livid or mottled, blebs or bullæ form, i.e. the cuticle separates from the cutis, and fluid, generally blood-tinged, is effused between them; the temperature of the part falls, it loses its sensibility, then the part turns black and decomposes, so that it crackles with emphysema. If cut into it is found sodden with foul serum; in extreme cases all the tissues of the limb are softened and separated from the bone. This is *mortification*. The next step is *sloughing*—that is, the separation of the dead parts—a purely inflammatory process, exactly analogous to that by which a foreign body, such as a dart, if fixed in the living parts, is loosened and thrust out. The living (perhaps better called half-dead) tissues adjoining the gangrenous part become inflamed, and thus a red line is traced around the slough, which is called the *line of demarcation*, and the formation of which proves that the gangrene has stopped, at least at the part where the line is found. Next the inflamed parts become infiltrated with leucocytes, which absorb and replace the natural tissues; these then suppurate, and thus a trench is dug around the dead part; granulations spring up and push off the slough, which is now loose and can be picked off. Very commonly one or two strings of cellular tissue resist longer the process of inflammation, and the slough requires to be cut away with a pair of scissors; and in the case of a limb the

¹ This is sometimes called 'chronic' gangrene, as by Travers.

bone takes far longer to separate than the soft part, and it is often necessary to divide it in order to rid the patient of the offensive putrefying mass. When the process of casting off the slough is completed the result is an ordinary granulating ulcer.

The general symptoms caused by an attack of gangrene are usually of a low or 'typhoid' character. The pulse is small, weak, and frequent, the tongue dry and brown, the appetite bad, and the strength failing. Death occurs from asthenia, and often very rapidly and unexpectedly.

In the treatment of gangrene the great question is, whether or no the part can be removed. Speaking generally, this is only advisable in cases of traumatic gangrene, although in some of the more favourable examples of the spontaneous form it may be done after the line of demarcation has formed.

Treatment.
Amputation in
traumatic
gangrene.

The first point is to distinguish between the cases which are purely *local* and those in which the gangrene is of the *spreading* variety. The former are best exemplified by cases of sloughing of the leg after ligature of the femoral artery or rupture of the popliteal vessels. In such cases the patient often remains without any severe fever, the gangrene extends gradually, but never reaches above the point where the vessels have been tied or injured, and the surgeon may choose his own time for amputation. If the patient be quite healthy, there is no motive for delay—the limb should be removed at once; while, on the other hand, in cases of gangrene after ligature, where the patient has been in a feverish condition from the previous disease or its treatment, I have seen the best results from waiting till the constitutional excitement had subsided. But the treatment of the spreading form of traumatic gangrene is a matter of far greater difficulty. Here the gangrene propagates itself above the seat of injury, and in many cases will spread indefinitely, whether with or without amputation, till the patient dies. The cause of this rapid propagation seems to be, in most cases, a diffuse inflammation extending along the planes of cellular tissue or up the course of the absorbents or veins, and due, as we are taught by the followers of Sir J. Lister, to the presence of septic organisms. In other cases, according to Mr. Cripps,¹ the spread of the gangrene is caused by blocking of the main veins in patients labouring under weakness or organic disease of the heart. In these latter cases, if we could distinguish them, there would be no motive for immediate amputation, since the surgeon could not hope to get above the limit of the thrombus in the vein, and if he did not do so, the gangrene would be sure to reappear in the stump. Such a course might be suspected when in a patient with feeble or diseased heart gangrene spreads somewhat slowly up the limb without the usual signs of acute inflammation preceding it, and then the surgeon would be justified in waiting for the line of demarcation. In the gangrene produced by acute spreading inflammation, amputation should be at once performed, if possible through healthy parts; and then a large proportion of cases will recover. When the whole limb is implicated, so that amputation has to be done through inflamed tissues, the operation must still be resorted to, though with a very diminished chance of success. In some cases, where the constitution is healthy, the patient will recover, without amputation he must inevitably die.

There are some exceptions to the rule usually laid down that amputation may be performed in traumatic gangrene. Thus in the gangrene which is caused either by heat or cold it is very rarely that amputation is successfully performed; for in burns the limb is generally scorched and partially disinte-

¹ 'Syst. of Surg.,' 3rd ed. vol. i. p. 133.

grated far beyond the part at which it is totally destroyed ; and in frostbite, though the disintegration is less visible, yet it is so real that in the Crimean campaign, where this injury was fatally prevalent, the surgeons at last gave up every form of operative interference, so uniform was the bad success—due no doubt in part to the general exhaustion of the patients, but partly also to the local effects of cold, extending beyond the frozen toes or fingers, and indisposing the tissues of which the stump is formed to take on reparative action. Gangrene from embolism might be thought to be a favourable case for amputation, and so it would be were it not for the concomitant heart-disease. In gangrene after ligature of the main artery we have perhaps the most appropriate example of the use of amputation in traumatic gangrene. Now, gangrene from embolism resembles this in many respects. The obstruction to the circulation is limited and definite ; and the condition can frequently be diagnosed, as it was in the instance here figured ; but as it is usually only a feature of a general disease which is necessarily fatal, and which would usually preclude recovery from a serious operation, we hardly ever see amputation practised in such cases.¹

On the whole, therefore, amputation on account of gangrene is more often practised before gangrene has set in, and when it is judged to be inevitable ; but when amputation is performed later on, the successful cases are generally those in which the surgeon has waited until the process has stopped.

If the surgeon has decided to save the limb, or if the gangrene is in a part which cannot be removed, the first indication is to wrap it up as completely as possible in some application which will deodorise the dead parts and stimulate the living to cast them off. For the latter purpose uniform gentle dry heat is very desirable ; animal charcoal or some tarry preparation, such as carbolic acid or creasote, may be applied to the sloughing part, and the whole wrapped up in a thick layer of cotton-wool. Moist heat should not be applied as it favours putrefaction. Some of the balsams, such as Balsam of Peru or Friar's Balsam (Tr. Benzoin. Co.), or resinous substances, are also much in use. An old and very useful application is the 'green

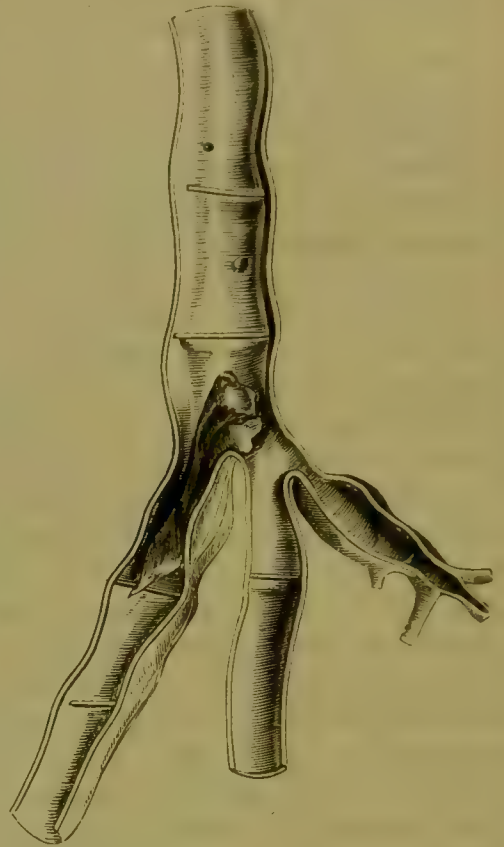


FIG. 11. An embolic clot, lodged in and completely obstructing the superficial femoral artery just as it springs from the bifurcation of the common femoral trunk. The clot was irregularly adherent to the wall of the vessel, which had a slightly roughened appearance at the point of contact. Elsewhere the lining membrane was natural and the vessel quite empty. At the upper end, corresponding to the deep femoral (which was unobstructed), the clot was scooped out by the action of the blood passing into that artery. The patient was admitted with diseased heart and dropsy, and in the course of that disease gangrene of the foot supervened. The nature and seat of the obstruction could be quite easily recognised during life. Blocks of fibrine were found in the spleen and kidney.—St. George's Hospital Museum, Ser. vi., No. 199.

¹ A case of amputation for gangrene, the result of embolism, is reported in the 'Gaz. des Hôp.' July 10, 1877. The stump was attacked with gangrene, and the patient died. Mr. Cripps gives an interesting example of successful amputation for gangrene the result of embolism in scarlet fever (op. cit. p. 123).

ointment' of the St. George's Hospital Pharmacopœia.¹ Many other local applications to gangrenous parts might be mentioned, but I think the principle of all of them is the same—to keep up the heat of the parts equal to or a little above the natural heat of the body; to stimulate the living parts and to deodorise the dead.

The general treatment of gangrene rests also on simple principles—difficult as it may be to apply them in practice—viz. to clear the alimentary canal and improve the digestion, so that the patient may be able to take such nutriment and stimulants as will keep him alive through the process; and to calm the nervous system and procure sleep by means of opium or some of its preparations, or, if these are not tolerated, by some other narcotic.

There are few cases of gangrene in which opium is not indicated, and this is especially the case the older the patient is; and there are perhaps none (at least none in which the gangrene is extensive enough to produce constitutional symptoms) where alcoholic stimulants are not required. But it is a great error to 'pour in' stimulants and narcotics without any reference to the condition of the tongue, pulse, and temperature. Narcotics are used chiefly to calm the patient and to avoid the exhaustion which excitement and pain produce; but opium when ill-borne will often make the patient semi-delirious, and will cause excitement and loathing for food, and so increase the exhaustion. In such cases the narcotic must be used cautiously and administered hypodermically or by the rectum, for many patients can tolerate morphia or opium in this manner who cannot take it by the stomach. But in some persons all opiates disagree, in whatever form or in whatever way they are given. Chloral, in full doses (say ℥j.), should be tried in such persons, or hyoscyamus, or Indian hemp in doses of gr. ss.–j. of the extract or ℥x.–xx. of the tincture, cautiously increased if it seems to agree. But no narcotic is nearly so certain as opium or morphia; and this is usually not merely tolerated in cases of gangrene, but the patient's general condition improves under its use, visibly and at once. Stimulants are used to procure sleep, to assist appetite, to steady the pulse, and to lower the temperature; but they will not do this unless they are digested. The judicious use of purgatives and the apportionment of the needful stimulant, both as to quantity and quality, to the patient's powers of digestion, will tax all the experience and resources of the surgeon, especially when the patient is somewhat advanced in life and has already ruined his digestion and health by the abuse of fermented liquors.

It remains to speak of some of the special forms of gangrene.

Special
forms.
Traumatic
gangrene.

Enough perhaps has already been said about *traumatic gangrene* as far as concerns the question of amputation. It may be useful just to remind the reader that the limb may be hopelessly disorganised, both in military practice by spent shot, and in the injuries of civil life by extensive crushes, without the skin being very much injured; the soft parts are separated from the bone, the pulse in the main vessels is stopped, and an attentive examination will leave no doubt of the necessity for amputation. I ought also to add that the indications for the removal of the limb are quite different in early and in late life. Injuries which after middle life call imperatively for amputation may

¹ The formula for this is—℞ Ung. Elemi lb. j., Ung. Sambuci ʒ iij., Bals. Copaib. ʒ iij. The ointments to be melted together and the Copaiba added to them after they have been removed from the fire, before they cool.

Ung. Sambuci is made with the fresh leaves of the elder (lb. ij.), prepared lard (lb. ijss.), and as much water as required.

in childhood or about the age of puberty be most reasonably treated on the expectant plan, the surgeon feeling confident that if gangrene sets in and amputation becomes necessary there will be no such profound traumatic fever as that which, in later life, almost precludes the hope of success.

Bedsore.

A form of gangrene which may be regarded as to a certain extent traumatic is that from pressure—*bedsores*, or ‘gangræna ex decubitu.’ They are usually found in debilitated and emaciated persons who have lain long in bed and whose weakness prevents them from shifting their position often or much. They form usually on the sacrum, buttock, hips, and heels. The skin begins to look red and thin, and then a circular black slough forms. The parts may slough so deeply as to open the vertebral canal, and the sloughing is often the proximate cause of death in cases which might otherwise get well. Hence the greatest care should be exercised in all chronic cases to watch the state of the part on which bedsores usually form, and no doubt careful and dexterous nursing will prevent their formation in many cases, though it is most unjust and untrue to say, as is sometimes said, that the occurrence of bedsores proves careless nursing. In order to obviate their formation the first thing is to contrive frequent slight changes in the patient’s position, to pad the parts where the bones press on the skin with air or water pillows, elephant-plaster cut into a ring, or some such contrivance, and to harden the skin by painting it with camphorated spirit or weak solution of nitrate of silver. If the redness still persists a soft poultice is, I think, the best application; and when gangrene is absolutely declared it must be treated locally, like any other form of sloughing.

A kind of bed sore is formed in fracture of the spine in which the sloughing is partly produced by loss of nervous influence. This will be spoken of under the head of INJURIES OF THE BACK. Sloughs somewhat similar to these also form spontaneously, or on parts exposed to slight pressure, in any acute disease of the great nervous centres.

The sloughing which is caused by tight bandaging is an illustration of gangrene from pressure with which we are happily unfamiliar in these days of improved medical education. Occasionally the formation of a small limited slough can hardly be avoided, but the mortification of the whole or great part of the skin of a limb is justly regarded as a proof of criminal negligence, and punished accordingly. In the unhappy cases where this has occurred amputation is often necessary.

Frostbite.

In *frostbite* the symptoms seen immediately after the injury are usually rather in excess of the real amount of destruction. Parts are cold, white, destitute of sensation and circulation, and seem condemned to inevitable death, which really will recover if they are patiently and gradually restored to the natural warmth. This is best done by rubbing the part gently with oil or with snow, and bringing the patient by degrees into a warmer atmosphere. If the circulation be too abruptly stimulated the frozen parts will probably slough. On the other hand, some time afterwards, the apparent is less than the real injury, since the parts which appear to be perfectly nourished are really incapable of sustaining the reparative process, and if operations be performed through them renewed sloughing or tedious ulceration will ensue. In the cases where gangrene sets in immediately it is of the dry form; the parts shrivel up at once, and never regain the warmth or colour of life. In other cases they perish from low inflammation, being unable to support the reaction which ensues on the return of the circulation. The treatment of frostbite, beyond the means required to restore warmth at first, involves no

peculiarity except that the affected parts should long be kept warmly wrapped in wool.

Hospital gangrene is an extreme form of sloughing phagedæna. The term 'phagedæna' has been applied to a combination of ulceration and gangrene, in which, as the ulcer spreads, its surface sloughs more or less deeply. Two forms of this affection are recognised, viz. *spreading* phagedæna, where ulceration is the prominent symptom, the sloughing being only superficial, and *sloughing* phagedæna, where the slough which forms on the surface of the ulcer is thick, black, and round in shape, and appears to involve a considerable depth of tissue, so that the sloughing is the prominent symptom; but underneath this slough ulceration is going on, and these ulcerating tissues will themselves rapidly perish.

Hospital
gangrene.

The disease which has been described to us by military surgeons¹ as 'hospital gangrene,' and of which we have been fortunate enough not to have seen any instances in the hospitals of this country,² is a severe form of sloughing phagedæna, accompanied by a constitutional affection which is usually, in fact almost always, fatal. Its cause appears to be general—i.e. to be contained in the atmosphere of the chamber in which it originates—and this seems to be usually the result of overcrowding, deficient ventilation, and uncleanness, acting on men depressed by wounds and possibly by defeat. The condition of the general atmosphere of the place may favour its development, but cannot induce it, for it is almost always observed that scattering the sick about the neighbourhood—even putting them into the open air under canvas—stops the outbreak. There can be little doubt that the disease is due to a specific poison of an organic nature, communicated to the wound by direct contagion, or possibly through the air. It is very probable that the flies which generally abound in such places may convey the poison from one wound to another. From this contagious property, of which many striking examples are given, the disease is sometimes denominated 'Gangræna contagiosa.' Many surgeons regard it as essentially identical with 'Diphtheria of wounds.'

The disease commences with pain and tightness across the forehead, small, quick pulse, anxious countenance, stinging pain in the wound, swelling and hardness around its edges. The discharge becomes thin, gleety, and blood-tinged, with masses like gruel suspended in it. In a few hours the limb becomes greatly swollen, with blue congested veins—if cut into, the cut edges look like raw pork, from the œdematous condition of all the parts. The wound assumes a circular form, and is covered with a thick black slough, or its surface turns white or ashy-grey. The affection is attended by constitutional or traumatic fever in its severest form, from which the patient often sinks in a few hours, and which in general goes on to a fatal termination. The awful mortality attending on this disease is attested by many sad histories of overcrowded military hospitals and transport-ships, as in an instance recorded by Mr. Holmes Coote of a French Crimean transport, from which sixty dead bodies were thrown overboard in a passage of thirty-eight hours.

When this formidable disease has invaded a hospital there seems no ques-

¹ As, for example, in Hennen's 'Military Surgery,' from the outbreaks of this disease during the Peninsular War; or Macleod's 'Surgery of the Crimean War.'

² In South's 'Chelius,' i. 68, may be seen an account by Lister of a severe outbreak of sloughing phagedæna in University College Hospital in the year 1841, which attacked a large number of patients simultaneously, and which he classed as 'hospital gangrene,' but no case proved fatal.

tion that the first thing which should be done is to empty the building of all the sick and wounded that it contains, isolating them if possible : and if that is not possible, putting them under canvas in the open air. The most minute attention must also be paid to the cleanliness of the dressings—every material with which the wounds are touched being burnt at once ;¹ the gangrenous surfaces should also be covered over with thick layers of charcoal, creasote, carbolic acid, or some other disinfectant, so that there can be no possibility of the conveyance of matter from one sore to another. The sloughing surfaces should be destroyed by means of an active caustic, of which, perhaps, fuming nitric acid is the best ; opium should be freely given and the patient's strength supported by liberal quantities of nutriment and stimulants. The cauterisation should be repeated as often as may be judged necessary, the patient being under anæsthesia.

Phage-
dæna.

The disease to which the name of hospital gangrene has been given—I think erroneously—and which has been seen of late years occasionally in our London hospitals, differs from the formidable affection above described in the essential particulars that little or no constitutional fever accompanies it, and that it involves very little danger of life. I make bold also to say that it differs in another respect, viz. that it has not been proved to originate from any hospital influence. We have had several outbreaks of this disease at St. George's Hospital, and have always found that it has been prevailing at the same time in the neighbourhood of the hospital, and has attacked persons who have had no connection whatever with the latter, so that the influences, whatever they were, which generated the disease could not have been confined to the hospital. It is, of course, theoretically possible that dirt and overcrowding might have generated the gangrenous affection both in private houses and in the hospital simultaneously. All that I can say is, that the efforts of numerous skilled enquirers, most ardently interested in discovering any such cause acting in the hospital, have hitherto failed entirely to detect it, and it seems to me both incorrect as a matter of science and unfair (I had almost used a stronger word) to call it by a name which implies that there is some proved and admitted unhealthiness in our hospital wards, when no such thing has ever been shown to be true. I prefer, therefore, to denominate this affection simply *Phagedæna*, and to confess that though there is a good deal of reason to suspect that it owes its origin, at least very frequently, to carelessness in hospital management, and particularly in the materials used for dressing wounds, yet that in very many cases it has been found hitherto impossible to verify this suspicion, and therefore impossible to explain the causation of the disease.

It occurs in two forms ; the *sloughing phagedæna*, the severer forms of which approach the local character of hospital gangrene, and which are characterised by the round black slough and its thickened border ; and the *spreading phagedæna*, in which the wound spreads with an irregular edge and a foul, sloughy surface. The depth of this sloughing from the surface of the ulcer is hardly ever considerable, though sometimes from the swelling in and around the sore it appears so. In the limbs it seldom extends below the deep fascia, though I have known it to do so, and for the same reason hæmorrhage is very rare.²

¹ It is not enough merely to scald or boil sponges. Mr. Coote relates that in an outbreak of phagedæna in St. Bartholomew's Hospital the extension of the disease in two instances was clearly traced to the use of a sponge which had first been applied to a gangrenous sore, then boiled, and afterwards applied to a healthy wound.

² It is well, perhaps, to point out that this remark does not apply to cases in which

The pain in phagedæna varies much. Sometimes wounds may spread to a very considerable extent with but little suffering, at others very large doses of opium are required to quell the pain.

The treatment of phagedæna should, I think, be mainly local; the surgeon should endeavour to procure a more healthy surface to the wound, by applications of which energetic caustics appear to me the best. If the subject be young and healthy, steeping the affected surface in nitric acid, the patient being under chloroform, almost always stops the phagedæna. If this should fail, or if the surgeon be unwilling to employ so strong a measure, the sore must be dressed with some detergent and stimulating application, such as those used in other forms of gangrene (see page 65). Mr. Hutchinson has lately introduced into practice a painless, and as it seems very efficacious, method of treating phagedæna, viz. by continuous immersion in hot water. The phagedænic part is immersed for about eight hours at a time in a bath of the temperature of 95° to 98°. After two or three sittings the sore has usually assumed a healthy appearance. Mr. Cripps says that this plan has been followed with extraordinary success in the venereal wards of St. Bartholomew's Hospital. The irrigation of the wound with a solution of carbolic acid or sulphurous acid is also sometimes a potent remedy in checking the gangrene.

With regard to internal treatment, some persons believe that opium exerts a specific influence on the spread of phagedæna. There can be no doubt that it is very useful, indeed necessary, to procure sleep and allay pain; but as to whether it exerts any specific influence there is considerable difference of opinion, some believing that it has no influence on the disease and that there are many cases which do not require its administration. It is always well, I think, to evacuate the bowels, and stimulants with nourishing food are usually indicated. Bark, quinine, and ammonia also seem to accelerate convalescence.

Senile gangrene is the indirect result of the calcification of the arteries common in old age. It occurs in two forms, the dry and the moist. In the former the disease is purely one of obstructed blood-supply, and the arteries will sometimes be found filled with clot for a very considerable distance. Billroth points out that in senile gangrene it is not merely the anatomical condition of the arterial wall that is in fault, but that there is frequently also disease of the heart, and a tendency to arterial thrombus, so that the gradual spread of obstruction up the tube of the main artery can be verified by examination during life. Cases of spontaneous gangrene are on record at all periods of life, even in childhood, though but rarely, and usually after acute blood-diseases, as fever. But it will be sufficient to describe here the two forms of senile gangrene, leaving the rare cases of spontaneous gangrene at other ages to be dealt with on the same principles. The purely dry form, which in my own experience has been decidedly the exception, is the result of mere obstruction; the toes (in some very rare cases the fingers) turn black and shrivel, usually without much pain or constitutional disturbance; then a line of demarcation forms, and the patient may recover. In rarer cases a finger may simply shrivel up, without any discolouration. In the other form there is considerable pain and much redness around the black parts, together with oedematous swelling of the part, and all the evidences of inflammation; and it is clear that the gangrene is partly

Senile
gangrene.

(as in sloughing after bubo affecting the deep-seated glands) the fascia may have been perforated before the phagedæna set in. In such cases the vessels are often exposed and occasionally give way.

inflammatory, being caused probably by some irritation making a call on the powers of the part which the deficiency of its circulation renders it unable to supply. In many instances the outbreak of the disease is referred, with great probability, to some trifling injury, often a cut received in cutting the toe-nails or a chafe from an ill-fitting boot. This form tends far less to limitation and therefore to recovery than the dry form. The disease is far more common in the male than in the female sex, and appears often to depend partly on visceral degeneration, the result of over-feeding, and is frequently marked also by a gouty tendency.

In the treatment of senile gangrene the first point is to support the patient's strength, and the second to maintain the warmth of the part, in hopes that the gangrene may stop. Opium must be given to allay pain, and it seems always to be well borne; the part must be wrapped in cotton-wool and well deodorised. Amputation is not looked on with favour by most surgeons, and the slight experience which I have had of it has not been favourable. Recently, however, Mr. Jonathan Hutchinson¹ has revived the recommendation, originally made many years ago by James of Exeter, of high amputation, i.e. amputation far away from the gangrenous parts, in senile and other forms of spontaneous, slowly advancing gangrene, and the practice is one which should, at any rate, be tested by trial in suitable cases.

There are two forms of gangrene which, singularly enough, are peculiar to childhood, viz. *cancrum oris* and *noma pudendi*. The two names have been confused, since some surgeons call *cancrum oris* also by the name of *noma*, but it seems to me better to keep the terms separate.

*Cancrum
oris and
noma.*

The former, *cancrum oris*, is a very formidable disease in its worst forms. It is due to some profound exhaustion of the whole system, and usually follows on one of the eruptive fevers (measles most commonly) in children who have previously been ill-fed, ill-nourished, and brought up in bad air—at least, I am not aware that it occurs in others—and in these it does sometimes, though not often, occur without any feverish attack acting as a predisposing cause. The cheek swells, turns red and hard, and then a black spot shows itself either on the cheek or on the gums; ulceration takes place, the gangrene extends itself to a variable distance in the soft parts, the breath becomes horribly foul, the gums are exposed, the bone crumbles away, and the teeth drop out. The child is usually very feverish and depressed. Death is very common, though not universal, even in severe cases.

Noma pudendi is a similar affection of the external organs of generation in little girls; sometimes it seems to be merely the result of dirt and neglect, and then usually more curable; at other times it is caused by the same general constitutional conditions as *cancrum oris*; and in such cases is much more dangerous. It begins either on the mucous or cutaneous surface of the vulva, sometimes, indeed, at a distance from it in the skin of the groin. The ulceration speedily assumes the sloughing form of *phagedæna*, and occasionally extends to a considerable distance, so as to cause great loss of tissue, and in some cases greatly to narrow the opening of the vagina after recovery. This, however, seldom takes place; more commonly after recovery the destruction is found to have been much more superficial than it seemed at first. Both in *cancrum oris* and in *noma*, death often takes place very unexpectedly, and without any post-mortem appearances to account for it. This has sometimes been explained in the case of the mouth-affection as being the result of poisoning from the imbibition of the foul gas generated

¹ 'Med.-Chir. Trans.' vol. lxvii. p. 91.

by the gangrene, and it may sometimes be so ; but such explanation is not applicable to the case of noma.

The pathology of these diseases is obscure. There seems, however, to be some grounds for believing that it is due to a specific poison of an organic nature, and closely allied to hospital gangrene, and sloughing phagedæna. It is true no organism has been isolated, nor has the disease been inoculated ; but Dr. Sansom, in an interesting communication to the Royal Medical and Chirurgical Society, has described certain mobile bodies in the blood in a case of cancrum oris, the inoculation of which in lower animals produced death from peritonitis or acute cellulitis, with reproduction of the mobile bodies in the blood.¹

The treatment of these diseases is similar to that of other forms of gangrene, but here it is still more essential to destroy the sloughing parts completely, which is best done, I think, by soaking them with strong nitric acid. The French surgeons, however, prefer the actual cautery. Chloroform must be administered, the cheek thoroughly exposed, and the acid applied slowly and carefully to every part of the sloughing surface. When the disease does not commence in the mouth it is most important to stop its spread before it has extended into the cavity.

Free stimulation with wine is almost always necessary, and the exhibition of tonics with diffusible stimulants. Chlorate of potash enjoys a great reputation, and may be given in any dose up to a scruple ; but I cannot say that I am convinced of its efficacy, and should be sorry to trust to it without the other and more powerful means of treatment.

Tetanus is defined as 'a tonic spasm of the voluntary muscles, with exacerbations ;' that is to say, the muscles affected are in a constant condition of spasmodic tension, and this is exaggerated from time to time into violent convulsive action.

Tetanus ;
its varie-
ties.

Tetanus is divided into traumatic and spontaneous. In this country it is almost always caused by an injury, and the most various, and sometimes the most trivial, injuries have been known to cause it ; but it occurs spontaneously even in this country, though rarely, and more commonly in the tropics.² Tetanus is also divided, according to its course, into acute, sub-acute, and chronic, and varieties of the disease are named from the muscles implicated, viz. trismus or lockjaw, when the muscles around the jaw are alone or chiefly affected ; opisthotonos, when (as not uncommonly occurs in the spasms of acute tetanus) the muscles of the back draw the patient's body into the form of a bow, the body resting on the head and heels ; emprosthotonos, when the abdominal muscles bend the body in the opposite direction ; and pleurosthotonos, when it is bent to one side. The two latter are very rare ; at least in this country. I have never spoken to any one who has seen an example of either. Trismus exists more or less at the commencement of all attacks of acute traumatic tetanus.³

The *symptoms* of tetanus are usually as follows : At any period after the receipt of an injury or after a surgical operation, with no especial premonition

Symptoms
of tetanus.

¹ 'Med.-Chir. Trans.' vol. lxi. p. 1.

² The spontaneous origin of the disease should not be admitted in any given case without enquiry. I have known a case regarded as spontaneous in which after death a wound was found which the patient had forgotten.

³ See Sir B. Brodie's evidence on Palmer's trial in the newspapers of the time, or Dr. A. S. Taylor's paper in 'Guy's Hospital Reports' for 1856, pp. 296, 297.

the patient begins to complain of an uneasy feeling of stiffness about the neck and lower jaw—‘stiff neck,’ as he probably terms it. After this there is difficulty in swallowing and chewing, and then complete fixedness of the jaws, the masseters and muscles about the upper part of the neck being felt firmly contracted. There is also commonly at an early period pain in the epigastrium, referred to affection of the diaphragm. Convulsive cramps now occur at any attempt to open the jaws or to swallow. There are sudden and violent cramps in the region of the diaphragm. The muscles of the abdomen and then those of nearly all the body are rigidly contracted, so that the abdomen feels like a board, and on handling the limbs they may be as stiff as in death, but the muscles of the wrists and fingers are usually exempt from spasm. The contraction of the facial muscles gives a sardonic grin to the features, ‘the tetanic grin.’ The tetanic state is now fully established. The pulse is usually unaffected, except during the spasms, when it is quickened. In the acutest cases, however, there is often great general fever, as the thermograph from a rapidly fatal case, on page 76, will show. The bowels are generally constipated and the motions scybalous. The spasms vary much in severity. They are sometimes so severe as to jerk the patient out of bed, and even to rupture the muscles.¹ Occasionally the tongue is protruded from the mouth, and, being caught by the closing jaws, is severely lacerated. The spasms are liable to be brought on by any sudden impression—a noise, the slamming of a door, a draught of air. Sleep is rare and short in acute cases. The contraction of the muscles either ceases altogether or is greatly relaxed in sleep. The intellect is not affected. Death seems to be caused sometimes by spasm of the glottis: but usually occurs from suffocation during a spasm produced by the stiffness of the muscles of respiration, or from exhaustion.

All this applies to the acute form of the disease; the sub-acute and chronic differ from the acute only in the course and severity, not in the character or order of succession of the symptoms. Speaking generally, the later after the injury the symptoms come on, the more chronic is the course of the disease, and therefore the greater chance is there of the patient’s recovery.

There is a form of tetanus, called *trismus nascentium*, which affects infants in the first or second week of life, and which has been connected by some authors with the section of the umbilical cord. It is very fatal, though instances of recovery are not unknown. Generally, however, this infantile tetanus ends in death much more speedily than the adult disease. Tetanus has also been known to be caused by parturition.

Nothing, or next to nothing, is known as to the predisposing causes of tetanus. It is much more common in hot countries than in cold, and it attacks persons of the negro race much more commonly than whites. Bad hygienic conditions seem to favour its development, as malaria, and possibly bad ventilation.

The idiopathic form of the disease seems far more common in the tropics than in this country. It has been referred to various causes, of which the best authenticated seems to be the sudden suppression of perspiration by exposure to cold and damp; and it appears that a loaded state of the bowels is at any rate a predisposing, and it has been looked upon as an exciting cause of idiopathic tetanus.

Diagnosis. Tetanus requires to be diagnosed from hysterical affections, from the

¹ Most museums contain specimens of one of the long muscles ruptured in tetanus. Thus in St. George’s Museum, Sec. iv. No. 1, is the rectus abdominis muscle torn across in a tetanic spasm.

convulsions produced by strychnia-poisoning, from epilepsy, and from hydrophobia. As above stated, the symptoms, in the early stage, are those of ordinary stiff neck (rheumatic affection of the muscles of the jaw and neck), but the progress of the case prevents any permanent confusion.

The diagnosis from hysteria is not always perfectly easy, and this will be evident from the simple consideration that tetanus may attack an hysterical person, and may be complicated with hysterical fits. But, ordinarily, hysterical lockjaw or any other tetanic symptom simulated by hysteria may be distinguished from the real disease by the patient's general condition and appearance, by the complete relaxation of the spasms from time to time, and by the fact that sooner or later the patient is sure to be able to eat.

From strychnia-poisoning the diagnosis may also for a time be very difficult, as the celebrated trial of the surgeon Palmer for the murder of a man named Cook by strychnia shows, in which many medical men swore that in their opinion the man died of tetanus, or of epilepsy with tetanic complications. But the same trial brought out very clearly the differences, viz. that the spasm from strychnia-poisoning commences and culminates with great rapidity, and without any previous stiffness about the jaws and neck; and that if the dose is insufficient to cause death the symptoms subside with equal rapidity, leaving the patient in perfect health, but for the exhaustion following the spasms; that there is nothing of the tonic spasm with convulsive exacerbations which characterises true tetanus. The spasms also of strychnia differ from those usually seen in tetanus in that they affect the muscles of the trunk and limbs only, and not the jaw, and that they affect the muscles of the wrists and fingers, which, as above noted, are usually unaffected in tetanus. These minor differences, however, could hardly be alone relied on.

From hydrophobia the differences are these; in hydrophobia the spasms are clonic—that is, the jaw may be spasmodically closed, but it will drop into complete relaxation—which is not the case in tetanus. In tetanus there is no dread of water, no aversion to it, though the attempt to drink may cause spasm, as any other excitement may; the countenance in tetanus, though distorted, is calm, unlike the glowing eyes and excited face of hydrophobia; and the state of the mind corresponds, being calm and collected in tetanus, wild and often subject to delusions in hydrophobia.

From epilepsy there are numerous distinctions. Any case of epilepsy likely to be mistaken for tetanus will in all probability be accompanied by insensibility, which is never the case in tetanus, and by blueness of the surface. And then there is the great distinction that epileptic seizures have complete remissions, i.e. the spasms are clonic, while tetanic convulsions are connected together by the tonic spasm.

Nothing is really known of the pathology of tetanus. There have been Pathology. cases in which a morbid condition of nerves has been found at the seat of the injury, and where the removal of the nerve so injured has been followed by immediate recovery. There have also been cases in which after death distinct evidence of inflammation of the trunk of the nerve has been found, extending to some distance, and others in which the spinal cord has been found inflamed. From which the inference has been drawn that the pathology of the disease consists essentially in inflammation propagated through the nerve or nerves injured to the spinal cord, thus exciting the general spasmodic condition. This explanation, though the most logical which has as yet been offered, is apparently contradicted by the anatomy of many cases in which the nerves have been found to all appearance healthy, and by

the course of others, in which the injured part has been removed, with no benefit; though, doubtless, in the latter cases the ill-success might be explained by supposing that the morbid condition of the nervous centre was already generated; and in the former it may be said with much plausibility that morbid conditions really existing may have been overlooked, in consequence of the method of research not having been sufficiently delicate. Lockhart Clarke¹ has described alterations in the minute structure of the spinal cord in tetanus, which may very probably have existed in many cases where the cord was put down as 'healthy,' since such changes would not be detected by an ordinary naked-eye examination of the cord, such as is usually made. To the same effect are Dr. Dickinson's observations,² and other pathologists have published similar cases. It is unnecessary to describe these changes minutely. Accurate plates from Dr. Dickinson's preparations are to be found in his paper. Suffice it to say that they show inflammatory exudation and extravasation of blood in the white columns, and softening of the central grey matter of the cord. Dr. Coats³ has confirmed these observations and has figured similar changes in the medulla oblongata. But other investigators, of undoubted skill, have failed to find these changes;⁴ and even allowing them to be constant, it would still remain the question whether they are the cause of the disease, or its consequence. However, if we do not regard the tetanic condition as being due to irritation of the spinal cord propagated to it through the injured nerves, we must take refuge in the vague theory 'that it results from poisoning with some peculiar substances which possibly are very rarely formed in wounds, and thence absorbed' (Billroth). Such a theory leaves our knowledge of the pathology and treatment of the disease just where it found it. But if we admit that the disease starts from irritation of the injured nerve, one practical conclusion of great importance would follow, viz. that the part should be removed, or the nerve be excised, divided, or stretched at the first definite symptom of tetanus, and I must say that such a rule seems to me a good one. Mr. Bryant⁵ mentions a case in which 'Mr. Key amputated a leg on account of tetanus, which had appeared six days after an unreduced dislocation of the astragalus. The symptoms disappeared at once after the operation. On dissecting the foot the posterior tibial nerve was found to have been put violently on the stretch by the projecting astragalus.' I have seen at least one similar case. That amputation usually fails, however, is quite true; and this we might expect, since the symptoms show that the irritation has already reached the central organ. Yet the chance that it may not have gone so far as not to be capable of recovery, if only the peripheral excitement is removed, justifies amputation, in my opinion, in appropriate cases. To be of any service it must be done early. The same end may possibly in some instances be effected by excision of a portion of the nerve, but it is rarely that the precise nerve can be isolated. Lately, both in France and England, tetanus has been treated by exposing and stretching the main nerves. Dr. Brown Séquard⁶ says that he is acquainted with twenty-three cases of tetanus in which nerve-stretching

Treatment.

¹ 'Med.-Chir. Trans.' vol. xlvi

² 'Med.-Chir. Trans.' vol. li.

³ 'Med.-Chir. Trans.' vol. lxi. p. 79.

⁴ Billroth says: 'Rokitansky states that he has found in the spinal cord a development of fresh connective tissue, from which it would appear as if we had to deal with an inflammatory process in this nerve-centre. My investigations of the spinal cord and nerves in tetanus have as yet given negative results only.'—'New Syd. Soc. Transl.' vol. ii. p. 69.

⁵ 'Practice of Surgery,' 2nd ed. vol. i. p. 244.

⁶ 'Syst. of Surg.' 3rd ed. ii. 219.

has been employed, and that eight of these recovered, and that in some at least of these 'the symptoms were quite severe;' and he thinks that the plan is worthy of further trial, if used together with some powerful internal remedies. All the nerves going to the part should be stretched; the stretching should be strong enough to destroy the power of transmitting sensitive impressions, and should be done as far away from the wound as possible. The general subject of nerve-stretching will be found treated in a subsequent chapter.

Irrespective of these surgical measures the treatment of tetanus is entirely empirical, and completely unsuccessful. Possibly we ought to except from this sweeping condemnation the application of ice to the spine, which has, indeed, some logical basis, inasmuch as it seeks to reduce the temperature, and thus to combat the inflammation of the part whose irritation is believed to generate the disease, and in that sense may be said not to be empirical, but it seems entirely unsuccessful. Nearly every drug in the *Pharmacopœia* has been tried, with occasional successes, but these successes have been obtained mainly in the subacute form of the disease. Acute tetanus, though not uniformly fatal, is very generally so, and the few patients who have survived appear to have recovered under quite different kinds of treatment. If life can be prolonged beyond the third week, recovery becomes probable, though instances of death up to the thirty-ninth day are recorded by Mr. Poland.¹ Therefore, in our present ignorance of the real pathology of the disease, and consequently of the effect of medicines on it, our great object is to keep the patient alive, till the time when, as experience teaches, the irritation may have worn out, and his powers may suffice to carry him through. Chloroform may be cautiously tried, and if it can be borne it will relax the spasms and permit the introduction of food into the stomach; but its exhibition often sets up an amount of spasm which threatens to prove fatal. Most patients can get enough fluid nourishment through the closed teeth to keep themselves alive, or they can be fed by a tube passed through the nostrils. If this is not the case life cannot be long supported by enemata, and under these circumstances I entertain no doubt that it is justifiable to induce anæsthesia at any risk in order to feed the patient. And in such circumstances the larynx may be opened, in order to obviate death from spasm while the patient is being narcotised. Also if death is threatened from spasm of the glottis laryngotomy may be performed. In one such case I saw much difficulty, from the neck being twisted, in keeping the incision near the middle line. Sleep is always to be procured by chloral or by morphia, which may be injected subcutaneously. The bowels ought, no doubt, to be unloaded at the commencement of the disease, and the purgation should be frequently repeated; the patient ought always to be kept in a cool, quiet, darkened room, and carefully defended from draughts and noises. As to the internal treatment, it is undoubtedly justifiable to use some of the medicines which have proved successful in other hands, or to try any new plan of treatment which affords a rational prospect of success. Of the former class, the administration of the tincture of aconite is, I think, on the whole the most promising. Five minims of the *Pharmacopœia* tinc-

¹ Out of 327 fatal cases, 79 died within 2 days.

104 „ in from 2 to 5 days.

90 „ „ 5 to 10 days.

43 „ „ 10 to 22 days.

11 „ beyond the 22nd day.

'Syst. of Surg.' 3rd ed. vol. i. p. 205.

ture may be administered in a small quantity of any convenient vehicle every two hours until some definite impression is produced on the pulse and temperature. In acute tetanus the temperature sometimes rises abruptly and continuously till the time of death, as in the case from which the annexed thermograph was taken ;¹ and it is in these cases that large doses of alcohol may be expected to prove advantageous ; but the use of alcohol as a specific, the patient being kept in a state of constant intoxication or semi-intoxication, seems to me not only useless but injurious. It would be vain to enumerate all the specifics which have at various times been recommended. They have all obtained their reputation from their success in a few cases, which were in all probability of the subacute form—a form in which recovery is common under any treatment, or under no definite treatment, if the bowels be kept free and the patient's strength supported by such food as he can easily take and assimilate. Opium, chloral, Calabar-bean, nicotine, turpentine, camphor, quinine, strychnia, curara, are the chief among the many remedies which have obtained some reputation, and some of these substances have been injected into the veins, as chloral. I will only say that those medicines which tend to constipation (as opium) seem to be mischievous ; those which are highly poisonous, as nicotine, curara, strychnia, appear to add a new danger to the disease, without any reasonable hope of benefit ;² and the same appears to be true of intravenous injection. Quinine is, I have no doubt, completely inert ; chloral, camphor, and turpentine are doubtless useful in subacute tetanus, and the first may afford some relief in the spasms of the acute disease ; but none of these, nor, as far as I know, any other medicine, seems to have any curative virtue in acute tetanus.

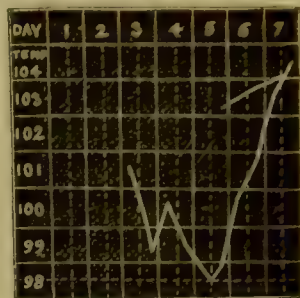


FIG. 12. Thermograph of Tetanus. From a case under my own care, which proved fatal 18½ hours after the first decided symptoms of the disease. The case is recorded in Dr. Dickinson's paper in 'Med.-Chir. Trans.' li., where the post-mortem appearances are described and figured.

Delirium tremens.

Delirium tremens, the delirious excitement which depends on chronic intoxication, is a disease which we have only too frequent opportunity of seeing in our hospital patients, both as a spontaneous affection (in which respect it falls within the care of the physician) and as a complication of surgical injury, in which latter respect alone I shall here speak of it.

The delirium which is excited in a patient labouring under chronic intoxication—that is to say, in one whose blood and tissues, especially those of the brain, are deteriorated by the too free use of alcohol—is marked by several

¹ The fullest description with which I am acquainted of the changes of temperature in traumatic tetanus will be found in 'Med. and Surg. Mem.' by Dr. Joseph Jones, New Orleans, 1876, vol. i. pp. 154 et seq., in which work numerous careful records of temperature are given, and the observations and opinions of all the authorities, ancient and modern, who have treated this subject are discussed. It seems clearly to result from what is known on the subject that in cases of subacute and chronic tetanus the variations of temperature are neither striking nor of any certain signification, but that a rapid and abrupt rise of temperature, such as is figured in the text, is usually a fatal indication. The temperature has been known to rise much higher than is here figured—temperatures of 112° and 113° are said by Wunderlich to have been noted immediately before or after death.

² Mr. Hulke, however, thinks that the extract of physostigma (Calabar-bean) hypodermically administered, in doses of ½ gr., deserves further trial. 'Syst. of Surg.' 3rd ed. i. 209.

peculiarities which distinguish it from the delirium of ordinary fever, as well as from any other form of aberration of mind. The main peculiarity of the delirium is its *busy* character, and the prevalence of one dominant idea which is generally distressing or alarming to the patient.¹ The delirium is not usually violent, and any person who is not afraid of the patient, and who can speak to him with authority, can generally control him. The next, and perhaps the most characteristic, feature of the disease is the *tremor* from which it takes its name, and which is generally seen in all the muscles, those of the tongue and face as well as the extremities, though it is most marked in the hands. Another and most painful symptom is the want of sleep, and indeed of any rest either of body or mind: and this sleeplessness will usually be found to precede the delirium. A restless, tremulous, feverish, half-rational condition commonly ushers in the defined attack of delirium. The general condition is also most unlike that of the delirium of either traumatic or any other fever. Traumatic fever may of course accompany the attack of delirium tremens in surgical cases, but apart from this there is little evidence of general fever. The temperature is not high,² the skin is usually bathed in a profuse sweat, the tongue, instead of being dry and brown, is moist, white, and cedematous, the pulse is small and quick, but not hard. There is almost always a loathing for food, and the patient often vomits. Evidences of visceral disease will often be discovered, especially in the kidneys and liver.

Treatment.

The treatment of delirium tremens used to be conducted on the anti-phlogistic plan, the disease being confounded with inflammation of the brain, and this treatment was very fatal. In the reaction from this error it became usual to treat the disease with enormous quantities of stimulants and of opium; and I cannot but think that this treatment, if pursued on a merely routine plan, is also unsuccessful, i.e. that it aggravates instead of diminishing the danger of the disease, though not to so great a degree as the depleting plan. In fact, every case of delirium tremens should be treated on its own indications. In the premonitory stage, when the occurrence of tremor, with some restlessness, in a patient known or reasonably suspected to be of drunken habits, gives fair cause for believing that an attack of delirium tremens is imminent, it is only too common to ply the patient with more stimulants, probably on the principle contained in the old proverb, 'A hair of the dog that bit you.' No treatment can have less support from logic, nor do I think that experience lends it any support either. In patients of drunken habits admitted into the hospital I make it a rule to give them no more stimulant than to a healthy and sober person, to purge them freely, supplying them with a good supporting diet, and to procure sleep by the subcutaneous injection of morphia if necessary; and under this regimen the threatening symptoms almost uniformly disappear. When the delirium is fully developed the same line of treatment should be pursued. The chief indications are to soothe the patient as much as possible, to procure sleep, and to enable him to take food. For the first purpose it is most essential to use no mechanical restraint if it can be avoided. In public institutions, where separate rooms can be obtained for the treatment of the case, and the services of a number of men can be procured if required, it ought to be very rarely necessary to tie down a patient suffering from delirium

¹ See Haward, 'Syst. of Surg.' 3rd ed. vol. i. p. 212.

² I believe this is usually so in cases of ordinary severity, but in fatal cases the temperature has been known to rise just before death as high as 108° F.—'N. Y. Arch. of Clin. Surg.' ii. 113.

tremens; and if unnecessary it cannot but be prejudicial to the case. In order to procure sleep opium or morphia must generally be given. The slighter cases may recover the power of sleep under free purging, as they regain that of taking food; but in almost all traumatic cases it is advisable to procure sleep at once, as the restlessness of the patient renders him liable to disturb the injured parts. Chloral with or without bromide of potassium may procure sleep in the slighter cases; but speaking generally the best agent for this purpose is morphia, which ought to be injected under the skin in a tolerably large dose (gr. $\frac{1}{2}$), and repeated in about half an hour, if sleep is not obtained, and so on until the patient does go to sleep. Mr. Marrant Baker has shown how much the narcotic power of the morphia injection is increased by the simultaneous administration of chloroform.¹ It may be well here, also, to give a word of caution against the injection of morphia, whilst a patient is under, or partially under, the influence of chloral. It may sometimes happen that a patient may have been ordered chloral, of which he has taken some doses without sleep being procured, and the surgeon may feel disposed under these circumstances to inject morphia subcutaneously; such treatment is fraught with danger, and I have known more than one instance where it has been followed by a fatal issue, apparently from cardiac syncope. The bowels should be kept very freely open, and it may be necessary to give some tonic—quinine, ammonia, or bark with mineral acid.

¹ 'St. Bartholomew's Hosp. Reports,' vol. xix. p. 249.

CHAPTER III.

POISONED WOUNDS AND ANIMAL POISONS.

THE inflammatory complications which we have been studying hitherto attack wounds of all kinds, irrespective, as far as we know, of anything special in the nature of the injury; but there is a large class of wounds in which the inoculation of some definite poison produces symptoms more or less peculiar. Poisoned wounds.

It would be endless to enumerate all the varieties of poison which may be conveyed into wounds, or all the various ways in which such conveyance may be effected. It will be enough for our present purpose to divide poisoned wounds into the three following kinds: (1) dissection wounds; (2) wounds produced by venomous animals; (3) wounds inoculated with matters which produce definite diseases.

Under this head are included all poisoned wounds, in which the poison introduced is obtained from some dead animal matter, and which include not only wounds inflicted in the course of dissection, and wounds received during 'post-mortem' examinations, but also the wounds which butchers, cooks, fish-mongers, and such like are liable to inflict on themselves in following their occupation. The wounds in which the poison is obtained from the tissues of an animal which has been some time dead are never so serious as those in which death has recently taken place. The wounds, therefore, inflicted in the course of dissection are rarely serious, and usually heal readily,¹ whilst sometimes, in post-mortem examinations, where the subject has been dead only a few hours, and especially where the death has resulted from some specific disease, the symptoms are of the most acute character and may speedily terminate in the death of the patient. In the former case, the poison is some putrid matter, the result of decomposition; in the latter, some specific virus is introduced. This naturally divides dissecting wounds into two classes: (1) the non-infecting and (2) infecting wound. Dissection wounds.

The influence of the non-infecting poison shows itself in various ways, depending probably to a great extent upon the state of health and constitution of the recipient of the wound. If the state of health of the person injured is good, probably no ill effects will follow the injury, but the wound will heal as any other wound would do in the same individual, or at all events will form only a local pustule. But if, on the other hand, the health be broken down by overwork or dissipation, or any organic visceral disease exist, much more serious consequences may ensue. Some individuals appear to be especially susceptible to the influence of the virus, and are rarely able to make a post-mortem examination without suffering from it. And it would seem that in these individuals a wound is not even necessary, but that the inoculation may pass through the unbroken skin. Again, others are peculiarly exempt from its influence, and it appears as if an immunity can be acquired by constant exposure, exactly as one can be acclimatised to any

¹ Possibly the preservative fluid with which the subject has been injected may have something to do with this.

other form of morbid influence. If the health of the person on whom the wound is inflicted is good and sound, no evil results of a serious nature ensue; either the wound heals like any ordinary wound, or else the poison exerts its influence on the tissues only with which it is brought directly in contact. A halo of inflammation takes place in the structures around the injured spot, all the vessels and lymphatic spaces become blocked by inflammatory exudation, and thus the part becomes fenced off from surrounding tissues. A small pustule may now appear, may burst or be opened, discharge a drop or two of pus, and the wound heal as a granulating sore; or from the pustule, a minute core may be extruded, which is a little mass of cellular tissue which has been killed by the virulence of the poison. In other cases where the health is not so good, the lymphatic spaces do not appear to become sealed, and the poison may be introduced into the lymphatic system, causing inflamed absorbents, with fever and disturbance of the digestive functions and diarrhœa; afterwards, perhaps, followed by inflammation and suppuration of the nearest lymphatic gland.

One other result of contact with decomposing animal matter must be mentioned—the anatomical tubercle or dissection wart (*verruca negrogenica*) which is found occasionally on the hands of dissectors and morbid anatomists. It consists in a warty thickening of the epidermis and papillary layer of the dermis, especially perceptible around the hair follicles, and sometimes associated with painful fissure or the formation of pustules.

The infective form of dissection wound is due to the introduction of some specific morbid poison, probably some form of micro-organism, and produces general effects out of all proportion to the amount of poison introduced. It generally arises where the subject from whom the poison is derived has died of some acute infective inflammation, puerperal peritonitis, erysipelas, pyæmia, &c. The exudation fluids in such cases always contain micro-organisms, which may be supposed to be the true source of infection, and if this is so it would account for the greater virulence of the poison shortly after death while these bodies are in a state of great vital activity. Some time after death they have perished and their virulence is destroyed. In these cases, shortly after the introduction of the poison, intense symptoms of blood-poisoning, with great nervous prostration, set in. The temperature rises to 104° F. or higher, the pulse is quick and weak, and there is great anxiety of countenance. The disease is frequently ushered in by a rigor, followed by profuse swelling. At the seat of inoculation, a small pustule usually forms, with an inflamed base. Diffuse inflammation of the cellular tissue of the axilla, chest, and back, rapidly running on to suppuration, speedily comes on, the patient rapidly falls into a condition of asthenia, with low muttering delirium, and frequently dies in a few days from the commencement of the attack. Or a low form of broncho-pneumonia may set in and terminate the patient's existence.

Treatment.

In this, as in all other cases, prevention is better than cure. All students know the importance of having the hands well greased or oiled when performing a post-mortem examination in a case of acute internal inflammation; and if they are unlucky enough to prick or cut themselves, the first thing is to tie a ligature tightly round above, and then the wound should be at once squeezed, so as to encourage a copious flow of blood from it, and it should then be sucked for a long time, so that all morbid matter may be sucked out of it. It may then be right to cauterise it thoroughly, and undoubtedly this plan gives more security against absorption of virus, but of course at the ex-

pense of some inevitable local inflammation.¹ On the first appearance of any unpleasant symptom, rest, country air, tonics, and generous living are essential. Most surgeons agree in thinking that the reason why dissection-wounds are so much less fatal now than heretofore is because the so-called 'antiphlogistic' has been superseded by the stimulant plan of treatment. When the characteristic symptoms are developed the treatment must be conducted on the same principles as in other cases of blood-poisoning. Rest of body and quiet of mind (if possible) are of great importance, but the latter is not easy to obtain. I have usually found that surgeons, when overtaken themselves by any grave surgical malady, are peculiarly nervous and apprehensive, as, indeed, is natural. Yet such apprehensions are more common in the subacute than in the acuter and more deadly form of the complaint, in which the mind is too much oppressed to have much room for fear, and therefore the inevitable anxiety may generally be relieved by the assurance that such cases almost always end well. The patient's strength must be supported by such food and drink as he can easily and comfortably digest; and Sir J. Paget testifies to the relief afforded by free and early incisions into the abscesses, and, I would add, into any inflamed part where tension is manifest, though no pus may be formed. And, as the same great authority intimates, it is probable that diligent and judicious nursing has quite as much to do with the patient's recovery as medical or even surgical treatment.

II. Wounds inoculated with matters which act as general poisons are chiefly those inflicted by the bites of venomous serpents, or the stings of venomous insects, though as to the latter, it seems that practically it is only the scorpion, and that only in very hot climates, whose sting produces any serious general symptoms. The insects of this climate, hornets, wasps, bees, &c., produce only local inflammation by their stings, and this so trivial as seldom to require any skilled assistance. Some form of ammonia (sal-volatile or eau de luce), indigo, in the form of the domestic 'blueball,' whitening, flour, ink, are some of the common remedies, enumerated in the order of their apparent efficiency. It is said that bees' and wasps' stings inside the throat sometimes produce a degree of swelling which requires scarification.

Wounds of
venomous
animals.

So also, in this climate, the bite of a snake usually produces local consequences only. The common snakes, are, of course, perfectly harmless—in fact, are common and favourite playthings of schoolboys—but the adder, or viper, is undoubtedly venomous. I never saw a case in which the venom produced any worse consequences than a sharp attack of phlegmonous erysipelas, though this may, of course, prove fatal. But the tropical snakes infuse into their bites a venom which acts as a specific poison, and in the most venomous species this poison is as rapidly and surely fatal as any substance known to pharmacologists. In the severest cases the effects are developed so rapidly as, according to Mr. Busk, to resemble those of prussic acid more than anything else, but usually an interval elapses. The symptoms may be divided into general and local. 'The first symptom, in nearly all cases, appears to be a general shock to the nervous system, attended with faintness, tremor, and great depression, sometimes with stupor, loss of sight, vomiting, trismus, and general insensibility. At the same time great and sometimes intense local pain is set up. The limb, if the wound is in one of the extremities, rapidly swells: at first pale, the surface of the swelling soon becomes red, and after-

¹ Some surgeons are opposed to the cauterisation of poisoned wounds. See Heath, 'Clin. Trans.' xiv. 120.

wards livid, and covered with phlyctenulae filled with sanious fluid. In severe cases the swelling continues to spread through the whole limb up to the trunk, or even through the entire body, whose surface assumes a jaundiced hue. The local symptoms, in fact, very closely resemble those of ordinary phlegmonous erysipelas. The constitutional symptoms, independently of the first shock, are what might be expected to accompany such a local affection, and in intensity are in proportion to its violence.¹ Mr. Busk points out the analogy between this dreadful poison and the ferments which act in the blood to develop the most formidable kinds of fever, as small-pox, and to the dissection-poisons of which we have just spoken. But he also dwells on the fact that, unlike those poisons, which produce (as far as is known) the same intensity of symptoms, whether they are introduced in small quantity or large, the serpent-poison depends for its intensity directly on its quantity in relation to the mass of the blood into which it is introduced; so that two bites will kill the same animal more quickly and surely than one, and a similar bite from the same serpent will act more intensely on a small animal than a large one. The situation of the bite also influences the rapidity and certainty of the action, a bite on the face or trunk being far more dangerous than one on the extremities. The knowledge of these deadly animals is essential to those who have to practise in tropical climates, but the present work is hardly the place for any description of them. I must refer the reader, for a condensed account, to the essay of Mr. Busk above quoted, and for more complete anatomical and zoological details to the special works on the subject, and particularly on the subject of the Indian snakes, to Sir J. Fayrer's great work, 'The Thanatophidia of India.'

The treatment of these injuries must be divided into the prophylactic and the curative. As in all poisoned wounds, the most effectual treatment is at once to tie a ligature tightly round the limb above the wound, to excise the part freely with a sharp knife, and then to suck the blood out repeatedly,² and cauterise the surface deeply before removing the ligature; or if the finger is the seat of the bite to cut it off at once.

But it is obvious that opportunities for adopting such precautions can very rarely be afforded. Then arises the question, is any other treatment of any avail? Now, it must be premised that the venomous serpents differ greatly in the activity of their venom; that the probability of inoculation and the intensity of the poisoning will differ according as the poison-gland is full or empty; and that a person may be bitten without any penetration of the skin having been effected, or any of the virus being brought into contact with the absorbent vessels.

Thus it is never quite certain, when a person recovers after the bite of a deadly serpent under a certain mode of treatment, whether he has recovered in consequence of the specific effects of the treatment, or in consequence of the insufficiency of the dose of the poison; and this objection has been made to the only method of specific treatment which it is in the least worth while to discuss, viz. the intravenous injection of ammonia, and made on the great authority of Sir J. Fayrer. He attempts to show that in wounds produced by the deadly serpents of India, when those wounds fairly penetrate the skin, the injection of ammonia into the veins rather hastens death than

The intra-venous injection of ammonia in serpent-bites.

¹ Busk, in 'System of Surgery,' vol. iii. p. 856; 3rd ed.

² It is usually believed that there is no danger in sucking the poison out of any wound, except the danger of there being a crack or wound in the mouth, by which the poison may be absorbed.

otherwise, and he regards the plan as positively hurtful. The recoveries which have ensued in Australia he explains as due to the less poisonous nature of the serpents of that country, or to the insufficient injection of the poison. Yet it must be admitted that in many cases of serpent-bite in Australia the poison seems to have been potent enough to produce death when no treatment has been adopted; that the symptoms described in many of the Australian cases have been very alarming, and that the treatment seems to have approved itself to persons of experience, so as to have come widely into use in the country in which it was devised. And as to the increased danger which the injection itself may cause, it is surely a matter of very slight importance. In a case which is certain otherwise to prove fatal in a very short time it matters little whether the treatment employed exposes the patient to the danger of dying a few minutes sooner, provided only that it offers any reasonable chance of safety. And I must say that to my mind it is quite clear that Prof. Halford's treatment, whether it is sufficiently energetic or no to combat the effects of the virus of the most deadly serpents, has acted beneficially, and, as far as we can judge from published accounts, has saved life in many of the bites from the Australian serpents, and deserves to be fully tested in those of other countries. Prof. Halford directs that the liquor ammoniæ fortior is to be diluted with two or three times its bulk of water, and of this mixture from 20 to 30 drops are to be injected into any vein which is available. If the symptoms are relieved, but the patient seems still in danger, the injection may be repeated as soon as the operator thinks it prudent.

If this treatment is delusive, no other is at present known: the various specifics so-called, such as the Tanjore pill, the decoction of snake-root, &c., are, I believe, admitted to be inert, and the only thing that can be done is to keep the patient alive by copious stimulation or artificial respiration.¹

III. The next class of poisoned wounds is that in which specific diseases are excited. These are wounds poisoned by the secretions from diseased animals, viz., Glanders, Hydrophobia, Malignant pustule (and Foot- and Mouth-disease).

Glanders in man is due to inoculation with a poison from a similar affection in the horse, mule, or ass. The disease in these animals shows itself in two forms; either as an inflammatory affection, rapidly running on to ulceration of the nasal mucous membrane, to which the term 'glanders' is applied by veterinary surgeons; or as a peculiar inflammation of the superficial lymphatic glands and vessels, with the formation of hard swellings (farcy buds) which rapidly form foul ulcers. This condition in the horse has received the name of 'farcy,' but the two diseases, glanders and farcy, are believed to be pathologically identical. Glanders.

The disease in man is due to accidental inoculation, or to the absorption of the specific poison through the unbroken skin in those who tend horses. The poison is probably a bacillus, and the incubation period in the acute form of the disease averages from three to eight days: in the chronic often as many weeks.

In acute glanders the disease is ushered in with general febrile symptoms, languor, aching pain in the loins and joints, and possibly a rigor. This is followed by a peculiar eruption, at first papular, but speedily becoming pus-

¹ An interesting summary of some experiments on intravenous injection and artificial respiration in snake-bite will be found in 'Brit. Med. Journ.' June 19, 1875.

tular, over the chest, abdomen, and face. These pustules speedily burst, and form foul unhealthy ulcers. Coincident with this, hard painful nodules appear in the subcutaneous tissue, and, breaking down, form deep excavated ulcers. Subsequently the eruption extends to the nasal mucous membrane, and the nose becomes swollen and red, with a fœtid, sanious discharge from the nostril. The inflammation from this may spread to the pharynx and air-passages, and to the frontal sinuses, and along the other channels opening into the nasal fossæ. The whole face becomes swollen and bloated, and enlargement of the lymphatic glands in the submaxillary and parotid region takes place. Occasionally these symptoms precede the appearance of the eruption and formation of the nodular swellings.

As the disease progresses the constitutional symptoms assume a typhoid type—exhaustion, with low muttering delirium, vomiting, and diarrhœa supervene; or a low form of pneumonia may manifest itself, and the patient may die in a few days from the commencement, or may linger somewhat longer, but as a rule the acute form of the disease terminates fatally.

Chronic glanders presents exactly the same train of symptoms as the acute, and differs from it merely in the slow way in which they develop themselves. The period of incubation is much more prolonged, dating back in some cases to several weeks, and the local symptoms are very slow in developing themselves. This variety of the disease may not prove fatal, though it is a very formidable disease; cases of recovery being very exceptional, and even when it does occur, leaving the patient crippled by long-continued suppuration and sloughing. In some cases acute glanders follows on the chronic form, possibly from auto-inoculation.

The treatment of glanders and farcy offers nothing that is peculiar. Its principles are, first, to disinfect and deodorise the discharge; and, secondly, to support the patient through the fever. For the former purpose the nose should be freely washed out either with creasote lotion, as recommended by Dr. Elliotson in his original paper in the sixteenth volume of the 'Medico-Chirurgical Transactions,' in which the disease was for the first time accurately described, or with Condyl's fluid or carbolic acid. Mr. Poland speaks with approbation of turpentine embrocations and fumigation with volatile stimulating antiseptics, conveyed through the medium of warm vapour. The second indication is to be carried out (as in dissection-poisons) by free and early incisions and the judicious use of stimulants and tonics.

*Equinia
mitis.*

Glanders, when fully developed, is hardly to be confounded with any other disease. Those who handle horses' feet when affected with a disease known to farriers as 'the grease' are liable to a slight pustular eruption in the hands and wrists, to which the name of 'equinia mitis' is given, in order to mark its origin and to distinguish it from the virulent constitutional poison of glanders. It is a merely local and perfectly harmless affection. The eruption consists only of the common phlyzacious pustules, instead of the hard shotty tubercles of glanders—there is no general disease—and the whole thing subsides in a few days, with cleanliness, and soothing applications. Such, at least, has been the course of those cases which I have seen, in all of which the hand alone has been affected; but one is recorded by Mr. Cock¹ in which the accidental inoculation on the nostril of the matter from a 'greasy' horse produced symptoms much resembling those of glanders. In

¹ 'Lancet,' 1851, vol. ii. p. 129.

other cases this eruption appears to have been identical with the ordinary vaccine eruption.¹

Perhaps the most awful of diseases is that which is derived from the bite of an animal suffering under dog-madness, or rabies, and unluckily the apprehension often produces mental torture hardly less terrible than the disease itself. It is consolatory, therefore, to be assured that the disease in animals is very far rarer than might be inferred from the constant cry of 'mad dog' which is raised whenever a poor cur being worried into a bad temper bites and foams at the mouth. Dog-bites are extremely common—hydrophobia much less common.

Hydrophobia.

The disease derives its name from the dread of water which its development causes in the human subject; but rabies in the dog causes no such dread; in fact, the dog generally seeks the water greedily, though possibly spasm may prevent him from swallowing it. The disease in the dog ought to be known, in order that proper precautions may be taken;² but this is not more the province of the surgeon than of any other person. A surgeon has usually to form his own opinion as to the presence of rabies in the animal which inflicted the bite from the account given him by the patient or his friends when applying for advice on account of the injury. I think I may say that the safest course—the one which is best for the patient, and that which is most likely to be correct in circumstances where anything like certainty is impossible (for it is difficult for any one not very familiar with dogs to distinguish the early stage of rabies when he sees it, and still more so to judge on the subject from another person's description)—is to be very chary in admitting that the suspicion of the animal's madness had any foundation, and to give the most favourable prognosis, yet, at the same time, not to neglect any of the precautions against the imbibition of poison which are used in other cases of poisoned wounds, and which are described on p. 80. When these precautions have been taken, or if, unfortunately, they have been overlooked, and any time over half an hour has elapsed, nothing further can be done; though, even at a later period, it is quite justifiable to cut out the bitten parts and cauterise the wound, in order to relieve the patient's own apprehensions, even if it cannot really affect the progress of the case.³ What distinguishes hydrophobia from every other form of poisoned wound is the great uncertainty of its period of incubation, and the incredible length of time during which the poison may remain latent, and yet ultimately break out in all the virulence of the disease. Many cases are recorded in which more than a year has elapsed between the receipt of the injury and the outbreak

¹ See a case reported by Mr. Langton in the 'Clin. Soc. Trans.' vol. x. p. 121.

² The reader will find a description of the symptoms of rabies in the dog by Trouseau ('Clin. Medicine,' vol. i. p. 693. New Syd. Soc.'s Transl.), on the authority of Monsieur Bouley, clinical professor to the school at Alfort, 'based on what he had seen himself, and on quotations from Youatt's work.' A brief notice of the symptoms of rabies in dogs is now usefully added to the back of every dog-licence issued by Government, which gives the main features of the disease.

³ In the 'Lancet,' November 24, 1877, will be found an interesting letter from Sir J. Fayrer, in which he relates a case where a gentleman had been bitten some hours before by a dog unquestionably rabid, and where the complete excision of the bitten parts, with cauterisation, was successful—at least no hydrophobia ensued. But the same letter also relates a case where of two persons bitten by the same rabid animal, one died of hydrophobia and the other escaped, though he was the medical man in charge of the patient and witnessed his agonising death. It seems to result from such cases that excision should be practised, even several hours after the bite, though the escape of Sir J. Fayrer's patient may have been unconnected with the operation.

of the disease—one in which as much as five years and a half intervened—and though we might believe that in some of these cases a mistake has been made, and the disease has been due in reality to another injury which had passed unnoticed, or that in others hysterical hydrophobia has been mistaken for the real disease, yet we can hardly resist the conclusion that (in some mysterious and hitherto perfectly inexplicable manner) the poison contained in the saliva of the rabid animal may remain inactive in some part of the body for weeks or months, and then at length pass into the mass of the blood. Yet the neighbourhood of the wound displays no visible peculiarity, nor the absorbent glands, nor any other part. The wound has usually quite healed, and the patient has often altogether forgotten the accident; so that the explanation which some have hazarded is quite insufficient—that the disease is really no affection of the body at all, but a mental disorder due to constant apprehension—a form of insanity. The disease undoubtedly originates spontaneously in the dog, but in the human subject it is only known as a consequence of inoculation.

Like other animal poisons, except perhaps those which are most virulent, the poison of hydrophobia is very uncertain in its action. Thus, if several persons be bitten, only one may suffer, as was the case in the instance which Dr. Marcet recorded in the first volume of the ‘Medico-Chirurgical Transactions.’ Trousseau estimates that about half the persons bitten take the disease; others estimate the proportion much lower. The disease begins not uncommonly with renewed irritation in the scar of the wound, or with irritation in the nerves leading from it, testifying to the fact that some morbid action is going on there. And there is often a period of sullen depression, a passion for solitude, and a change of temper and disposition exactly analogous to the first stage of rabies in the dog. There is also a general feeling of bodily *malaise*, differently described in different cases, but often referred to the nape of the neck, and sometimes mistaken for rheumatism or stiff-neck. Feverishness then succeeds, more or less marked in different cases, and then, at a variable period, the peculiar and characteristic feature of the disease manifests itself, viz. that any attempt to swallow fluids will produce severe paroxysms of dyspnœa; and in the worst cases these paroxysms are produced not only by attempts at drinking, but by swallowing anything, and even by the sight or the very idea of fluid, and in some cases they occur spontaneously. As the case proceeds, the mind, which was at first quite calm and reasonable, sinks under the agony produced by thirst and by constant restlessness, and the patient becomes more or less insane; yet is usually quite under control, and easily made conscious of his own delusions. The excitement increases, the eyes become wild and staring, the whole countenance expressive of rage mixed with terror; the patient is in a constant state of excitement, and gets hardly any sleep, and that little is unrefreshing and imperfect. As is also noticed in the lower animals, the sexual feelings are often inordinately excited, producing satyriasis and involuntary emissions, or, in a female, nymphomania. After this stage of excitement and mania often follows one of exhaustion, in which the patient recovers his reason and his power of swallowing, but dies of asthenia; at other times he dies in a furious stage, either exhausted or suffocated.¹ Some few instances of apparently genuine hydrophobia which have recovered have been reported.

It must be added, also, that though the disease is named from the dread

¹ Trousseau seems to regard asphyxia as the usual if not almost the universal way of death in these cases.

of water, and though that symptom is a dreadful one, and the convulsions which drinking occasions may be terrible, yet patients who have sufficient resolution may overcome it, and may even take considerable quantities of fluid, and endure the contact of water in washing, as may be seen in the account of Dr. Marcet's patient above referred to.

The identity of the diseases of rabies in the dog and hydrophobia in man has been established by inoculating dogs with the saliva of hydrophobic men and producing rabies.

As to the real pathology of the disease nothing is known. That it consists in some disturbance propagated from the medulla down the eighth pair of nerves is clear enough; for though the leading phenomena of the disease have fixed attention chiefly on the mental disturbance produced by the sight or touch or thought of water, and the spasms which follow on attempts at drinking, we must remember that the disturbance is corporeal as well as mental, and the spasms are the effects of true reflex action proceeding from irritation of the hyper-sensitive afferent filaments. This is strikingly illustrated by a case which Trousseau relates (*op. cit.* p. 684), where an œsophagus-tube was passed through the nares and seven ounces of broth poured into it. Half of the broth had been conveyed into the stomach, when the pharynx and œsophagus were thrown into such violent spasm as to compress the tube and prevent the further passage of the broth, and the spasm spread to the respiratory muscles with such force that the patient very nearly died.

The post-mortem appearances do not, however, throw any more light on the nature of this irritation of the medulla or eighth pair of nerves in hydrophobia than they do on that of the spinal cord in tetanus. The fauces, pharynx, and stomach are found congested, and congestion of the brain and other internal organs has been noted. The most characteristic and constant changes which have been found are those of degeneration of the ganglion cells in the nuclei of the hypo-glossal, pneumo-gastric, and glosso-pharyngeal nerves, with thrombosis of the small vessels and round-celled infiltration of the perivascular sheaths in the cerebral cortex and medulla. Klebs believed that some highly refractive corpuscles which he found in the submaxillary and lymphatic glands was the vehicle by which the disease was transmitted, and Gibier describes a micro-organism which he found always in animals which he had inoculated with the virus of rabies.

The diagnosis of this affection seems easy enough. It appears that it may be mixed with tetanus,¹ but otherwise it can hardly be confounded with it, nor is there much difficulty in distinguishing the real from the hysterical (or, as Sir J. Paget would call it, the 'neuromimetic') form of hydrophobia. The course of the two diseases is quite different; the implication of the larynx in the spasms, so constant in hydrophobia, is absent in the simulated affection, and in the latter the patient is sure in the course of time to be able to swallow naturally.

The treatment up to the present time has, unfortunately, been quite unsuccessful. Surgeons have thought that if the patient's strength could be kept up for a certain length of time the irritation would disappear—and perhaps it might, but the attempt has hitherto proved futile. Forcible feeding, as in Trousseau's case above referred to, has produced such tremendous spasms as almost to kill the patient at once. Probably the administra-

¹ See Ogle, in 'Brit. and For. Med.-Chir. Rev.' 1868.

tion of chloroform or the attempt to perform tracheotomy would do the same; yet it is a perfectly fair experiment to try until the experience of a few cases shall have demonstrated, as I fear it would, its inefficiency. It is suggested by Trousseau's translator, Dr. Victor Bazire, on the theory that the essence of the disease is asphyxia, and that if death by asphyxia could be prevented the patient might be saved. A great deal might be said against this view, but I need not detain the reader with the discussion in this place. Some have suggested excision of the nerve supposed to be affected, or amputation of the limb. Either operation may be justifiable under given circumstances, but neither holds out much rational prospect of success. Three patients are said recently to have recovered under the use of curare, and it seems that this drug is the most promising medicine which we possess for the treatment of hydrophobia. It should be administered at once, on the recognition of the disease, either by the mouth or hypodermically. One third of a grain was given in one of the successful cases, repeated as often as its effects appeared to be passing away; in another case three grains were injected during the space of $5\frac{1}{2}$ hours; and in a third, quantities were used gradually augmenting from $\frac{1}{16}$ to $\frac{1}{2}$ grain every third hour.¹

Within the last few months M. Pasteur has recorded a remarkable series of experiments which tend to prove that the dog can be rendered insusceptible of rabies by inoculating him with the attenuated virus of rabid animals, much in the same way as vaccination protects man from small-pox. He has shown that if the virus taken from a dog suffering from rabies is inoculated into a monkey it becomes so much modified or attenuated that, if the virus from the monkey be now inoculated into a dog, it has the effect of rendering the animal insusceptible to the true virus of rabies, but without producing any of the symptoms of the disease. With suitably attenuated virus he has recently inoculated many human subjects who have been bitten by rabid animals, and though the question must still be regarded as *sub judice*, the results which he has obtained are sufficiently satisfactory to make us believe that the 'method will prove a boon to humanity, a gain to science, and justly merit the applause of the human race.'²

Malignant
pustule.

Malignant pustule, Charbon, Anthrax, Woolsorters' disease is a disease communicated to the human subject from herbivorous animals, suffering from 'splenic fever.' It is a disease which has attracted considerable attention, as its etiology has been definitely established and the disease proved to be due to the inoculation of a specific micro-organism, the 'bacillus anthracis.' The disease is a rare one in this country, since splenic fever only occurs sporadically amongst our cattle, and principally occurs amongst the tanners of foreign hides imported from places where splenic disease is endemic. It usually begins, at a variable period after inoculation, by intense itching at the seat of inoculation. This is followed by the appearance of a small red pimple, which speedily vesiculates. This bursts and forms a little black eschar, surrounded by a halo of redness, in which secondary vesicles rapidly develop. The appearance of the disease is then quite characteristic, a raised, inflamed area, with a central black depression, surrounded by a circle of vesicles. Very striking features in the disease are the remarkable freedom from severe pain, the little increase in the temperature of the part, the dryness of the slough, the absence of pus, and the fact that the destruc-

¹ See Anderson, 'Syst. of Surg.' 3rd ed. vol. i. p. 341. ² 'Lancet,' March 6, 1886, p. 457.

tion of parts proceeds from the surface to the deeper parts, and not in the reverse direction, as in carbuncle or abscess. The complaint is prone to destroy life by a rapidly fatal form of septicæmia, in which there is great depression, with headache, sleeplessness, and sometimes delirium. Dyspnœa and, in bad cases, cyanosis are also present, and towards the end diarrhœa, vomiting, and great exhaustion. Post-mortem examination reveals the blood and tissues everywhere infiltrated with a rod-shaped organism, about half the length of the diameter of a red blood corpuscle, presenting transverse markings and in their interior ovoid spores. The treatment of the disease, if adopted early, is eminently satisfactory. The entire removal of the primary lesion is generally followed by recovery. The removal of the disease must be very thorough, the surgeon taking care to cut in every direction through healthy tissues and wide of the disease, and the subsequent application of the thermo-cautery to the surface of the wound appears to give additional security. The subsequent constitutional treatment of the patient must be nutritive and stimulating, so as to enable him to throw off the poison which has already been absorbed into the system, and to keep him alive until this has been done. Fluid nutrient food, beef tea, eggs and milk, with stimulants, are indicated, and, as medicine, large doses of quinine.

There is little to be said on the subject of foot- and mouth-disease, as hitherto it has not assumed any great importance. The milk of cows suffering from this disease may produce a similar condition in human beings, especially children. The symptoms are those of stomatitis, with a vesicular eruption on the inside of the mouth and on the tongue, and in some cases on the fingers and nails, and more rarely on the feet, breasts, &c. In young children there is sometimes severe inflammation of the mouth, throat, and tongue, and irrepressible diarrhœa. Otherwise the prognosis is uniformly favourable, and the complaint seldom lasts much more than a week.

Foot- and
mouth-
disease.

The most important matter connected with this disease is to be aware of its existence, to take precautions for the supply of pure milk, and for boiling before use any which is at all suspected. Sulphurous acid $\text{m}\nu\text{--xx}$. in syrup of orange-peel and water has been found beneficial.¹

¹ Anderson, 'Syst. of Surg.' vol. i. p. 348.

CHAPTER IV.

HÆMORRHAGE AND COLLAPSE.

Hæmor-
rhage.

HÆMORRHAGE, its causes, sources, and treatment, forms a most important part of practical surgery, and in the judgment of many eminent surgeons it is in the treatment of unexpected and profuse hæmorrhage that the resources and qualities of a great surgeon are displayed more than in any other emergency. The topic follows naturally after the consideration of wounds and their treatment, since hæmorrhage is a symptom in every wound, and is the chief and most important symptom in many. Still a great number, perhaps the majority, of the cases of hæmorrhage which surgeons are called on to treat, are not traumatic; and the reader will see in the sequel that there are few surgical diseases in which the question of hæmorrhage does not at some time occur. It will hardly be possible, therefore, to exhibit in this place an adequate view of all the causes of hæmorrhage in surgical practice, nor, indeed, would it be desirable to repeat here matter which must form a great part of the sequel of the book.

Hæmorrhage may be looked at from several different points of view. Of these, the most important, and those to which I shall here confine myself, are two—viz. (1) as to whether the hæmorrhage is spontaneous or traumatic, and (2) as to whether the bleeding is from one or more large vessels (arteries or veins), or from a great number of small ones.

The
hæmor-
rhagic dia-
thesis, or
'hæmo-
philia.'

Spontaneous hæmorrhage is best illustrated by that curious affection, which is seen occasionally in this country, and more frequently, it is believed, in Germany, called the *hæmorrhagic diathesis*. In this diathesis there is a constitutional predisposition to bleed, sometimes with no previous injury, but commonly after some slight wound, very frequently that of the removal of a tooth, or some other trifling laceration; and the hæmorrhage will proceed, sometimes, unchecked by treatment, until the patient is exhausted, when it commonly stops, though in rare cases it proves directly fatal. It is more common for death to follow some other disease, which the patient would if stronger have thrown off.

The constitutional tendency is hereditary, and usually in the males of the family. Females suffer also from the disease, but more rarely—an exemption which has been attributed to the natural outlet provided by menstruation. And it is asserted that men who have hæmorrhoidal discharges sometimes procure thereby the cessation of the hæmorrhagic diathesis. It seems, however, that though females suffer less frequently than males, the diathesis is commonly received through the mother. It is not, however, always inherited nor always congenital; and it is said that the diathesis may be excited by privation of exercise and confinement in a damp, unhealthy place.

In some cases the hæmorrhage is periodic; and it is sometimes preceded by a distinct warning—a period of excitement, in which the pulse beats excessively; the patient is restless, and perceives an odour of blood in his nostrils. Some days after this the bleeding will begin, or if an injury is received the wound will bleed forthwith. In the intervals between the attacks of hæmorrhage a peculiar affection of the joints may be noticed.

This in most cases is due to hæmorrhage into the joint, but it is probable that some of the swellings are purely inflammatory. It is accompanied by severe pain, and so long as it is present the tendency to bleed seems to be suspended. The nature and situation of the hæmorrhage vary; subcutaneous hæmorrhage (petechiæ), bleeding from the nose and mouth, hæmaturia, and melæna are the most common.

The treatment is generally successful. If the patient is strong enough to bear it, free watery purging (as by Glauber's salt, sodæ sulph., in $\frac{3}{4}$ ss. doses) seems very beneficial, and the exhibition of some salt of iron (the carbonate is the favourite preparation) in the intervals between the hæmorrhages is often a great adjuvant. When internal hæmorrhage occurs, the ergot of rye is highly recommended, and may be given in 5-grain doses every half-hour. External hæmorrhage is best controlled by well-regulated pressure, aided by some astringent, of which the perchloride of iron is the best, or in some cases by the actual cautery. In some instances it has been noticed that the bleeding has ceased on converting a lacerated wound into a clean incised cut, and venæsection has even been practised with advantage; but it seems unnecessarily dangerous to make fresh wounds in a case where any cut may bleed uncontrollably.

Treatment.

The general symptoms of hæmorrhage are as follows:—When profuse and rapid (as, for instance, when a large artery is laid open), the patient rapidly faints, or, if the hæmorrhage is less excessive, the pulse and temperature fall, and he feels weak and faint; languor, yawning, noises in the head, throbbing of the temples, and flashes of light in the eyes precede the access of syncope. When syncope occurs, the bleeding as a rule stops; but if this is not the case, in consequence either of the size of the vessel or from some mechanical impediment to its closure,¹ the patient must die unless the bleeding is arrested by surgical treatment. Generally, however, it does stop, but sometimes recurs with the same train of symptoms, only more rapidly ending in syncope. On recovery from syncope vomiting often takes place, the pulse rises rapidly in rate, but not in volume, being weak, small, and easily affected by any external agency.

General symptoms of hæmorrhage.

The recurrence of hæmorrhage after syncope is prevented by the blood forming a clot in the bleeding vessel and in the tissues around it, which the returning circulation is too weak to displace; and this process is greatly favoured by the contraction and retraction of the arteries when completely divided, as will be explained further on.

Repeated or habitual hæmorrhage produces a general pallor, or rather a waxy appearance, of the whole body, fainting on slight exertion, restlessness, emaciation, sometimes partial or complete amaurosis, and frequently constant and extreme drowsiness. As it goes on, the patient becomes more and more weak and exhausted, sometimes entirely unconscious, pulseless, and livid. Death takes place usually in a very sudden manner, or is caused by some slight exertion.

Symptoms of repeated or habitual hæmorrhage.

It is hardly possible to estimate correctly the quantity of blood-loss which is necessary to occasion death. It varies much with age—infants succumbing rapidly; much with the patient's state of mind—a hæmorrhage which would

¹ The main mechanical obstacles to the closure of the vessels are their dilatation by heat (as in the case of vessels wounded in the interior of the body), their being kept open by the walls of a bony or fibrous canal in which they lie, their partial division, and the presence of foreign bodies in their interior.

not prove fatal if the patient were unconscious may easily cause death when his mind is agitated and his heart under the influence of terror; much with the temperature in which he is placed—bleeding which would not prove fatal if the patient were in a warm place may cause death when the heart is embarrassed by the resistance offered by tissues congealed by cold; with the organ affected, and with the condition of health or disease in which he may happen to find himself.

It has often been noticed that after repeated bleedings (either accidental or therapeutic) the blood becomes watery, more prone to escape from the vessels, even without injury, and less apt to coagulate.

Injuries of arteries.

The bleeding which occurs in most wounds proceeds chiefly from the capillaries and from small vessels which cease to bleed spontaneously. But bleeding from the larger arteries must be at once stopped, or else it will prove fatal, or at any rate cause a most injurious loss of blood.

The injuries of arteries may be thus classified:

1. Contusion. 2. Partial laceration. 3. Complete laceration. 4. Partial division. 5. Complete division.

Contusions.

1. About contusion of arteries little is really known. It seems undeniable that contraction and even total closure of the artery may follow on mere contusion, and that this may be a cause of gangrene. So Guthrie relates a case in which a bullet passed between the popliteal artery and vein without opening either. Gangrene ensued, and the man died. 'The coats of the artery were not destroyed in substance, though bruised; it was at this spot much contracted in size, and filled above and below with coagula.'¹ But such injuries can hardly occur uncomplicated, nor can the exact condition of the artery be diagnosed. They must be treated by the ordinary rules for traumatic gangrene.

Laceration of internal and middle coats.

2. Partial laceration of the artery consists in the tearing of the internal and middle coats while the external coat remains entire. I once had an opportunity of seeing the symptoms of this injury so clearly marked that it was easy to diagnose both the nature and the precise seat of the lesion. A man was brought into St. George's Hospital with a very severe injury to the head, caused by a fall from his horse, of which he died in 3½ hours. On examining him about an hour after his admission there was no pulse in one wrist; on the other side it was perfectly natural. The pulse had been felt in both wrists when he was first brought into the hospital. In the axilla the pulsation could be felt down to a certain point, and there it stopped at once. There was no bruise nor any other injury in the armpit. It was easy to see that the axillary artery had been partly torn at this spot, and that the torn coats had been pushed into the tube of the vessel by the blood so as to close



FIG. 13. The axillary artery, showing laceration of its two internal coats, which have been dissected, by the force of the blood-stream, from the external coat for about half an inch, and turned down into the cavity of the vessel so as to block it up. *a* shows the coagulum lodged above the reversed portion of the inner coats; *b*, the sheath of the vessel, which was perfectly natural.—From St. George's Hospital Museum, Ser. vi. No. 95.

¹ Guthrie, 'On Wounds and Injuries of the Arteries,' p. 22, case 24.

the tube, and the condition of the artery was exactly verified by post-mortem examination, as is represented in the annexed figure.¹

The injury here is not exactly the same as that which is inflicted by the surgeon in the operation of tying the artery. Under these circumstances the internal and middle coats are cleanly cut, as with a knife; they are not separated from the external coat, and there is no curling up in the lumen of the tube. When, however, these coats are ruptured by a crushing, twisting force, they are separated from the external coat, and by virtue of their elasticity and contractility become curled up in the interior of the vessel, leaving the external coat exposed for a considerable extent (see fig. 13). This may expand into a false aneurism (see the section on Aneurism), but generally becomes blocked with coagulum and the artery obliterated.

3. Rupture or complete subcutaneous laceration of an artery is most commonly seen in the popliteal and axillary vessels. It must be the result of great violence, and is, therefore, usually accompanied by other lesions. The circulation ceases, the pulse disappears from the arteries below, the temperature of the limb rapidly falls, enormous extravasation of blood below the fascia distends the limb; in some cases a bruit can be heard. I have never seen any case where pulsation was present in the extravasated blood. Gangrene rapidly ensues if the limb is not amputated. Such cases are easy of diagnosis from the rapid fall of temperature, the great swelling, and the loss of pulsation in the arteries below the seat of injury.

Rupture or
complete
laceration :
subcuta-
neous.

But I have seen cases where some amount of circulation went on, and where pulsation was at first perceptible, though feeble, in the arteries below, yet where gangrene set in, though not so rapidly;² and after amputation the artery was found completely separated into two parts. Either the blood at first found its way from one end of the artery into the other, the rupture being complete, or, as is more probable, the laceration was at first incomplete, but the untorn part of the vessel afterwards gave way.

If the diagnosis can be made with certainty, primary amputation is the safest course in the lower limb. In the arm the surgeon would tie the vessel if the swelling were increasing,³ or if not would trust to pressure on the artery above, with careful bandaging of the whole limb, and a compress at

¹ The reader may consult with advantage an interesting paper by Mr. Charters Symonds ('Guy's Hospital Reports,' 1884, p. 275), which contains an excellent *résumé* of the subject.

² A case is related by Mr. Pick, in 'Path. Trans.' vol. xvii. p. 74, in which the laceration was at first incomplete, and the patient was able to walk several miles after the accident. Gangrene came on very gradually, and amputation was not performed till thirty-five days after the injury. The two parts of the popliteal artery were still united by a fragment of the anterior wall of the vessel. Mr. Rivington has related in the 'Brit. Med. Journ.' Jan. 12, 1878, a very interesting case in which the popliteal vein was completely torn across, while the internal and middle coats of the artery were lacerated. There were also other lesions. In this case a clicking sound was heard with the stethoscope, caused by the flapping backwards and forwards of the lacerated coats inside the artery, there being still a feeble pulsation in the tibial vessels. In Dr. Fenwick's case referred to in the next note, the pulsation in the lacerated artery could be clearly traced with the stethoscope by a humming sound which ceased at the injured spot.

³ A very interesting and instructive case is reported in the 'Brit. Med. Journ.' Sept. 29, 1883, by Dr. Fenwick of Montreal, in which the axillary artery was lacerated, along with simple fracture of the humerus two inches below the joint. The arm was rapidly turning cold, and gangrene was threatened from the pressure of the extravasated blood. On the wounded artery having been tied and the clot turned out, the arm recovered its temperature and the patient completely recovered.

the seat of injury. But in the upper extremity, as in the lower, when gangrene has commenced amputation, should be no longer delayed.

Complete laceration of exposed artery.

The total laceration of an artery in a wound, as when a limb is torn off by machinery, does not usually give rise to hæmorrhage; the artery is twisted by the force exactly in the same way as it is by the surgeon in an amputation, and it can be seen pulsating down to the lacerated part. The process by which it is closed will be described under the head of Torsion, further on.

Incomplete division.

4. The incomplete is often a more serious injury than the complete division of an artery, since the wounded artery is prevented from retracting. Thus, when arteriotomy was a recognised operation, the anterior temporal artery was punctured, and would continue to bleed as long as the puncture in the vessel corresponded to that in the skin. When the surgeon wished to stanch the hæmorrhage he cut the vessel across.

The direction of the wound is of some importance in reference to the probability of future mischief. Thus, if a longitudinal wound be inflicted on an artery in a living animal, and the wound be afterwards examined, it will be found to be a mere slit, while a transverse wound gapes open and becomes oval, or rather lozenge-shaped, in consequence of the state of longitudinal tension in which the vessel normally is placed, rather than from any retraction of the muscular fibres. Mr. Savory shows that a similar shape is assumed by transverse wounds made after death, and that on dissecting the artery away and removing it from the body the wound closes again.¹

An artery partially divided will go on bleeding until some efficient external obstacle is opposed to the exit of blood, and this is often effected by the displacement of the various layers of tissue overlying the vessel (so that the wound in the artery no longer corresponds to that in the skin), and by the accumulation of blood-clot in the interspaces. When the bleeding stops, the wound may close like any other wound, or it may give way to the distending force of the circulation till a traumatic aneurism has formed, as will be shown in speaking of ANEURISM.

There is another form of incomplete division, very rarely met with, in which the weapon has divided the external coats of the vessel, but without penetrating its tube. As it seems certain, however, that the internal (or internal and part of the middle) coat which has been left uncut will yield to the force of the circulation afterwards, this injury is to be regarded and treated exactly as a wound penetrating the vessel.²

¹ Savory, 'On the Shape of Transverse Wounds of the Bloodvessels.'

² For an illustrative case see Guthrie, 'On the Diseases and Injuries of Arteries,' pp. 328-29. A gentleman had cut his throat, inflicting a punctured wound on the internal



FIG. 14. Diagrammatic representation of complete division of an artery. The ends of the vessel (*a a'*) are seen to be retracted, i.e. drawn up into the sheath; and contracted, i.e. compressed into a conical shape by the contraction of the circular muscular fibres. The part of the sheath thus left vacant, the ends of the vessel, and the tissues around the sheath are represented as filled with clot. The clot often extends as far as the nearest branch on either side, tapering as it extends up the vessel, and clot is also poured out external to the sheath. The cut in the sheath (*b b*) is here represented as a linear fissure. In practice the sheath would gape more widely, as it is on the stretch.

5. When an artery is completely divided, it *retracts* and *contracts*. It retracts since it is always on the stretch, and therefore when divided its ends separate, exactly as those of any other elastic tube would do, and it contracts from the irritation of the injury acting on its circular muscular fibres and causing them so to narrow the calibre of the vessel that it tapers out into a conical end within the sheath.¹ This contraction of the muscular fibres offers an obstacle to the circulation of blood through the vessel, and therefore to the occurrence of hæmorrhage, which is in proportion to the strength of the muscular coat, and is therefore much more efficient in the smaller arteries, where the muscular coat is very much stronger relatively to their size (and therefore to the pressure of the blood-stream on them), than it is in the great arteries, where it is entirely unable to resist the pressure of the circulation. Hence the total division of a large artery by a clean cut proves fatal at once unless the vessel is promptly secured, whilst arteries of smaller calibre will cease to bleed with or without the assistance of syncope. John Hunter says that he believes if a leg were amputated with no precaution for stopping hæmorrhage that the patient would not usually bleed to death, i.e. that arteries the size of the tibials would generally close spontaneously.²

Complete division.

All injuries of veins are less formidable in their immediate consequences than similar injuries of arteries of the same calibre, in consequence of the diminished force of the circulation, and of the weakness of the walls of the veins, whereby the pressure of the neighbouring parts and of the extravasated blood is enabled to act on them much more powerfully. It is, therefore, much easier to stop venous hæmorrhage than arterial, and it is hardly ever necessary to tie any except the largest veins and those which are kept open by the walls of the canals in which they lie. But contusion, laceration, or any other injury to a vein may have very serious and even fatal after-consequences, quite apart from any danger of bleeding. Thus, Mr. Syme³ has shown that many of the deaths after ligature of the arteries may with great probability be attributed to injury inflicted on the accompanying vein: and since surgeons have been more alive to this consideration the mortality after ligature of arteries has, I believe, decreased considerably. Further observations on this topic will be found in the chapter on DISEASES OF THE VEINS.

Injuries of veins.

Another very formidable consequence which sometimes follows wound of a vein is the entrance of the air into it. When the air rushes into the vein in such large quantities as to fill the right auricle of the heart with air it usually produces instant death,⁴ for the air passes through the auriculo-ventricular jugular vein and a scratch on the carotid artery. Guthrie took up the punctured portion of the vein with a tenaculum, and included it in a ligature. The wound in the vein healed, and the ligature came away, leaving the vein pervious and without a trace of injury. The artery was not interfered with, and it gave way on the eighth day, causing so much hæmorrhage that, although both ends of the vessel were secured as soon as possible, the patient died of exhaustion soon afterwards.

Entrance of air into veins.

¹ In Hunter's works, vol. iii. pp. 157 et seq., will be found some very interesting experiments on the contraction of the muscular fibres of arteries in the lower animals under the stimulus of exposure and loss of blood, and on the length of time during which they retain their vital property.

² 'An artery of moderate dimensions,' says Guthrie ('Dis. and Inj. of Arteries,' p. 222), 'such as the tibial or brachial, and particularly all below these in size, are in general capable, by their own intrinsic powers, of arresting the passage of the blood through them, without any assistance from art, or from the surrounding parts in which they are situated.'

³ 'Principles of Surgery,' p. 97.

⁴ This is sometimes done experimentally in killing horses. A pipe is inserted into

valve and opens it; then, on the contraction of the ventricle, the air, being a much lighter fluid than blood, cannot shut the valve flaps, and so the heart's action comes to a stop. When a smaller quantity passes in, the patient faints, but recovery often ensues. The entrance of the air (which, in practice, always occurs in surgical operations) is denoted by a whistling sound, after which syncope at once occurs. As far as I know, this has only hitherto occurred in operations on the neck or axilla, though it seems possible in other regions also: ¹ and it appears to have become much rarer, if not altogether unknown, since operations have been more generally performed under the influence of full anæsthesia, the accident being no doubt often caused by the patient's struggles. The vein having been imperfectly divided, and being prevented from entirely collapsing by its adhering in part to the surrounding tissues, some sudden movement draws the incision open while the motion of the chest in inspiration is producing a tendency to vacuum in the venous system.

Treatment. The first thing to do is to compress the wounded vessel with the finger, so as to prevent the entrance of more air. Treves has recommended that the wound should be filled with water, so as to prevent the further entrance of air, and at the same time to allow any air to escape which can be forced out of the right side of the heart, by compressing the chest-wall during expiration.

The remedies are those for profound syncope, viz. the recumbent position, forcing the blood towards the heart by chafing the limbs, exciting the heart to action by galvanism, administering ammonia by the nostrils and brandy by the rectum, and possibly, if there be time for it, injecting warm water into the veins in quantities of about 2 ozs. at a time.

The occasional occurrence of this dreadful accident will of course teach the surgeon caution in dissecting-operations about the neck and axilla.

Diagnosis
of the
source of
accidental
hæmor-
rhage.

When a surgeon is called to a case of hæmorrhage his first care is to stop it for the moment, which is always readily done, if there is an open wound, and the bleeding comes from a definite point, by moderate pressure with the finger on the bleeding spot. The bleeding even from a very large artery, if cleanly exposed (e.g. the femoral in a wound in the groin), requires remarkably little pressure to check it for the time. And if the bleeding point is not plainly visible, well directed pressure on a pad of some soft substance filling the whole wound will suspend the hæmorrhage until time has been obtained for the definite treatment.

Arterial or
venous?

Next, the question occurs—Is the hæmorrhage arterial, venous, or capillary?

Let us suppose a large artery wounded, and the wound in the artery corresponding directly to the skin wound. The blood leaps out, of a bright red colour, in jets synchronous with the heart's beats, and often to a distance of some feet from the patient's body. In the wound of a large vein, on the other hand (phlebotomy is a familiar instance), the blood pours out in a dark purple (Modena-red) stream which is continuous, and, if jetting at all, the

the jugular vein, and then if about thrice as much air is blown into the vein as a healthy man can emit at one full expiration, the horse will fall dead. See Moore's essay in 'Syst. of Surg.' vol. i. p. 372, 3rd ed., to which I must also refer the reader for a full discussion of the various theories about the manner of death in these cases. I have only stated in the text the one which seems to me the most satisfactory.

¹ Dr. Cordwent has related a case of parturition in which he believes that death occurred from entrance of air into the uterine veins ('St. George's Hospital Reports,' vol. vi.).

jets are not interrupted, but only augmentations of the force and extent of the stream, synchronous not with the heart's action, but with expiration or with muscular efforts.

So far there is no difficulty with the diagnosis. And in the case of smaller arteries there is also no difficulty so long as the flow of blood is unobstructed by the superjacent tissues. But in small wounds, even of considerable arteries, lying deeply, and having a circuitous communication with the exterior, the bleeding may be so gentle that there is little to distinguish it from venous oozing in its manner of coming out or in its colour, for venous blood quickly turns red on its exposure to the air. In this case the persistence of the hæmorrhage is a valuable sign that it is an artery which is wounded; and the effect of pressure above is another. Pressure applied to the nearest accessible trunk between the wound and the heart will suspend arterial hæmorrhage; while, if it affects the venous bleeding at all, it will augment it. If a bruit can be heard it will of course be decisive.

Having settled that the bleeding is arterial, the next question is whether it comes from a trunk artery or a branch. The bleeding caused by a wound of a branch close to its trunk (as of the superficial pudic near the common femoral, the circumflex iliac near the external iliac, or the sural near the popliteal) has been constantly mistaken for a wound of the trunk itself. The main diagnostic sign is that the pulse in the lower part of the artery is very much more affected (not necessarily, however, suppressed) when the artery itself is wounded than when one of its branches is cut across, and the persistence of the hæmorrhage is a valuable sign of lesion of a main trunk.

From trunk
artery or
branch?

When the hæmorrhage has been diagnosed to be from a trunk artery no time should be lost in securing it. If the position of the wound permits it, a tourniquet, or finger pressure, should be placed on the artery at some distance above the wound, or Esmarch's bandage applied; then the wound should be enlarged sufficiently to permit an easy dissection of the wounded vessel, and the artery should be tied above and below the hole in it, and divided between the two ligatures. If the wound in the artery is not at once visible, the relaxation of the tourniquet will show the surgeon where the bleeding comes from, and will lead him to it. A ligature above the wound only will sometimes stop the bleeding, especially in arteries of the lower limb; but even here it is far more safe to tie the vessel above and below the wound. If this is not done, the lower end will probably begin to bleed as soon as the circulation is re-established; and it is an old observation, on which Mr. Guthrie used to lay very much stress, that the bleeding from the lower end is of a venous character, both in colour and flow.¹ This is certainly true of the arteries of the lower limb, but in the neck, and frequently in the upper extremity, both ends will bleed *per saltum*. It may be advisable sometimes to place a temporary ligature round the trunk vessel, as recommended by Mr. Rivington,² when the wounded artery is inaccessible or cannot easily be found. Having secured the artery, the surgeon must examine the vein, or if there is a wound of a large vein, the bleeding from which is increased by the application of the tourniquet above, it may be held in check during the operation by another tourniquet below.³ When the wounded vein has been exposed the surgeon

Treatment
of wound
of artery.

Of wound
of vein.

¹ Guthrie, 'Wounds and Injuries of Arteries,' p. 248.

² 'Clin. Soc. Trans.' vol. xvii. p. 79. See also a paper by Mr. Treves, 'Lancet,' Jan. 1888, p. 111.

³ The application of Esmarch's bandage is usually more convenient on this account than that of the tourniquet, but some surgeons prefer the application of the tourniquet or finger-pressure in consequence of the facility of relaxing and reapplying it.

must choose for himself, according to the size of the wound and of the vein, whether he will trust to pressure, or tie the vein as well as the artery. The superficial femoral and its vein have often been tied together (by John Hunter, Roux, &c.), the popliteal artery and its vein for a wound (by Mr. Holthouse), and the common carotid and internal jugular in removing a tumour (by Langenbeck), without bad consequences.¹

If no tourniquet can be applied above the wound the operation becomes far more difficult and dangerous. The leading case here is one in which Mr. Syme tied the carotid artery when wounded at the root of the neck.² The left forefinger must be inserted into the wound (which is to be cautiously enlarged for that purpose sufficiently to admit the finger) so as to control all bleeding. Then, with the help of his assistant, the surgeon must bring the artery into view above his finger (i.e. between his finger and the heart), and when he has scratched it bare, and tied the ligature round it, he may remove his finger, clear all the clots away, and secure the distal part of the vessel.

If the wound in the skin has been commanded by pressure, and there is no bleeding, the surgeon may think it better to wait, in order, should a traumatic aneurism form, to treat it afterwards. But if the extravasation of blood be plainly increasing, the case should be treated just like a recent wound.

When the bleeding has been arrested by pressure it is, as a rule, unadvisable to disturb the dressings at all.

There are cases in which it is justifiable to tie the artery at some distance above the wound, as in aneurism. Thus, if the wounded vessel be inaccessible, as when the internal carotid has been wounded through the mouth, the common trunk has been tied with success;³ or when the patient has already lost a great deal of blood, and the surgeon thinks that a prolonged operation and deep incisions would prove fatal, the artery has been successfully tied above, where it was more superficial.⁴ But this must be allowed to be only a *pis-aller*, and if it fails to check the bleeding the patient will be in very serious danger. The only case in which the practice is recognised is that of a wound of the palmar arch.

Ligature
of artery
above the
wounded
spot.

¹ See the account by Mr. Annandale ('Lancet,' April 24, 1875) of a case in which he tied the popliteal artery and vein in a case of arterio-venous aneurism. See also a very interesting case by Mr. Sheild ('Med. Soc. Proceedings,' vol. x. p. 261), in which he tied the common femoral artery and vein on account of hæmorrhage from a sloughing bubo. The patient died on the eleventh day from pyæmia, but no gangrene occurred. The vein was obliterated below the entrance of the saphena, which had no doubt been the main channel for the re-establishment of the venous circulation.

² Syme's 'Observations in Clinical Surgery,' p. 154.

³ See Mr. H. C. Johnson's case, in 'Lancet,' 1850, vol. ii. p. 118. This case is evidently alluded to in Mr. Guthrie's 'Commentaries,' 6th ed. p. 256, where he proposes to secure the internal carotid artery when wounded from the mouth by an operation in which the ramus of the jaw is to be divided along with the internal pterygoid muscle, and turned up, the styloid process and its muscles with the glosso-pharyngeal nerve dissected, some of the styloid muscles divided, &c. No surgeon would, I am sure, trust himself to attempt such an operation, and it is rendered the more unjustifiable by the fact, pointed out by Mr. W. H. Cripps, that it is usually not the internal carotid, but some branches of the external which are wounded in injuries of this sort. For this and other reasons Mr. Cripps proposes first to tie the external carotid, and afterwards, if necessary, the internal carotid near the bifurcation ('Med.-Chir. Trans.' lxi. 229).

⁴ See Mr. Bulteel's case, 'Lancet,' 1859, vol. ii. p. 236, where a man was found nearly dead from hæmorrhage after a wound of the femoral deep in the thigh, probably in Hunter's canal. The surgeon, thinking that a long and difficult dissection must prove fatal in the desperate state of the patient, tied the artery in Scarpa's triangle, and the patient recovered without further bleeding.

In some cases also in which the wound and the limb generally are much inflamed it may be more prudent to tie the artery higher up ; as recommended by Dr. Campbell of New Orleans (in a paper referred to on page 105) ; and the success of this practice in such inflamed wounds has led to the proposal of ligature of the main artery of the limb as a method of treating complicated wounds and diffuse inflammation of the limb generally.

There are rare cases in which the surgeon departs from the usual rule, of not tying an artery unless it is bleeding. These are mainly cases in which he judges, by the severity of the previous bleeding, that a large vessel has been wounded, and that the hæmorrhage will probably recur, and when the patient must be left at a distance from competent aid. Otherwise it is better to put careful pressure over the wounded part, and leave a tourniquet loosely applied over the trunk above, with instructions to the nurse to screw it down if the bleeding recurs, and send at once for the surgeon.

The ligature of arteries was a method of suppressing hæmorrhage so infinitely superior in every way to the cautery, which was previously in vogue, in freedom from pain, in ease of application, in efficacy, in safety, and in immunity from future ill-consequences, that it is hardly to be wondered at that Ambrose Paré, its inventor, declared that he considered it almost a divine inspiration. The mode of application of a ligature varies according as it has to be applied to a vessel in its continuity, or the cut end of an artery has to be tied in an open wound. It will be well first to describe the method of ligaturing a vessel in its continuity. The skin and all other tissues which cover its sheath must be divided according to rules based on the known anatomical relations of each artery, and which will be found in the sequel. The sheath is recognised by the pulsation of the vessel beneath it, and by the absence of the white colour of the wall of the artery. It is pinched up with a pair of fine forceps, and a small nick is made in it with the knife held horizontally, so as not to

Ligature of arteries.



FIG. 15. Aneurism-needle. The point is rounded or blunt, and has an eye in it.

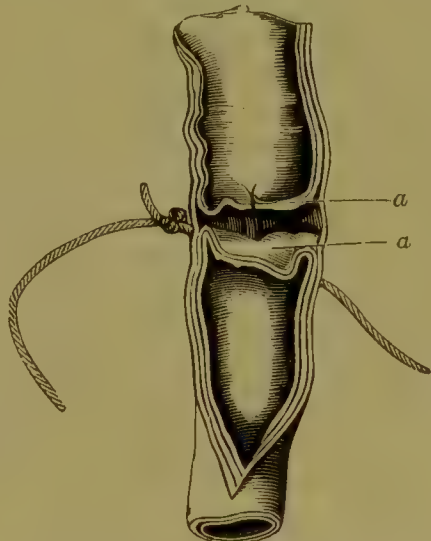


FIG. 16. An artery tied with a stout ligature and then laid open. *a a* show the internal and middle coats divided and turned down for a short distance below the ligature, in order to expose the undivided external coat.

endanger the artery. This little opening is enlarged with the point of the director till the aneurism-needle can be easily passed round the naked vessel. The sheath is only to be disturbed so far as is absolutely necessary for this purpose. The ligature is then to be passed and the knot tied gradually and firmly,¹ with as little disturbance as possible to the vessel. The knot must be a reef knot, and not a 'granny,' which would slip.

¹ Mr. Barwell ('Med.-Chir. Trans.' lxii. p. 230) has laid stress on the supposed advantage of tying an artery with a force only just sufficient to occlude the vessel without dividing the internal coats ; and more recently Mr. Ballance and Mr. Edmunds (Ibid. vol.

Process of
repair after
ligature.

The immediate effect of the ligature is that the internal and middle coats are cleanly divided, as if by a knife (fig. 16), and the external coat is strangled. The changes which now ensue are as follows. The blood coagulates in the interior of the artery, the coagulum extending in many cases to the nearest considerable branch on either side of the ligature. It is conical in shape, filling the whole tube at the point of ligature, and gradually tapering off to the first collateral branch. At first this clot is black and soft, but it soon becomes firmer, and, especially towards its base, of a buff colour. Occasionally, however, no clot forms in the artery, and its presence does not appear to be a necessary factor in the occlusion of the vessel. When present its size depends upon the distance between the ligature and the nearest collateral branch. The thrombus or clot thus formed becomes organised, and this would appear to be effected by the cells of the tunica intima which proliferate and form a new connective tissue that penetrates and replaces the clot.

During the first ten days or so after the ligature the clot contracts and forms channels or fissures, which constitute a kind of mechanical vacuolation, but in which there is no true circulation. During the next period the cells of the tunica intima which have formed the connective tissue invading the clot arrange themselves so as to present the appearance, under the microscope, of a vascular network, and finally become hollow and permit of a true circulation taking place, by penetrating the tunica media and anastomosing with the vessels of the adventitia.¹ While these changes have been going on within the vessel, other changes have been going on around it. The injury which has been caused by the ligature induces inflammatory changes and the exudation of lymph within the sheath in the neighbourhood of the wound. If the ligature was in the first instance septic, or afterwards becomes so, suppuration takes place; the lymph is converted into pus, and the ligature separates and comes away by ulcerating its way through the external coat of the vessel. There is therefore after the fall of the ligature a time at which the artery consists of two parts, though these soon unite again.² The



FIG. 17. Portion of a femoral artery tied some months before death. A very small part, *b*, of the vessel (about $\frac{1}{4}$ in.) is reduced to the size of a piece of whipcord, being completely obliterated. Except a very small pale coagulum just below this narrowed part, the whole artery above and below this part is quite pervious and healthy. *a* shows the profunda artery, the chief branch above the ligature; and a large branch which comes off some distance below is also seen.—St. George's Hospital Museum, Ser. vi. No. 147.

lxix. p. 443) have published an experimental inquiry, by which they profess to prove both the possibility and advisability of so occluding the vessels. As to its possibility, it is not, I think, contested, and had been made tolerably certain by previous investigators. But its desirability is, I must say, to my mind, still unproved; against the somewhat slighter injury which is or may be done to the wall of the vessel by the looser ligature is to be set the greater uncertainty of the occlusion of the vessel.

¹ On the subject of the organisation of the thrombus found in an artery after ligature see a paper by Dr. S. Delépine, 'Brit. Med. Journal,' Aug. 20, 1887.

² Lately some of the surgeons of St. Bartholomew's have reintroduced an old method of exposing a considerable extent of the artery, passing two ligatures and dividing it between them. Mr. Holmes has discussed this subject in a correspondence with Mr. Walsham, to which the reader is referred ('Brit. Med. Journ.' 1883, April 7, June 9, July 21). Mr.

separation of a ligature from a large artery such as the femoral occurs usually in about a fortnight, but may remain fixed for a much longer period. If on the other hand an aseptic ligature has been employed, and it remains aseptic, no suppuration takes place. The lymph which has been effused around the ligature becomes vascularised and converted into granulation tissue, the corpuscles of which slowly absorb and replace the strangled portion of the vessel and the ligature itself, if it is absorbable. If on the other hand the ligature is not absorbable, it remains embedded in the mass of granulation tissue, which becomes converted into cicatricial tissue. The ends of the vessel, thus separated from each other, remain permanently embedded in a mass of scar tissue, which assists the internal clot in maintaining perfect sealing and occlusion of the vessel. When a very quickly absorbable ligature

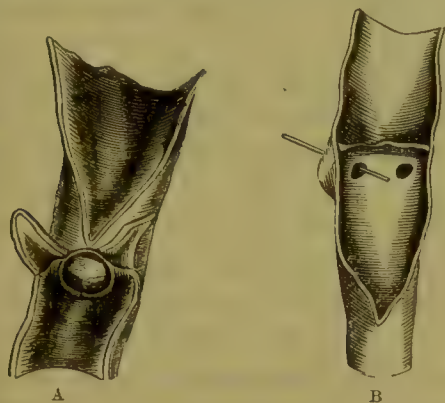


FIG. 18. A, the subclavian, and B, the common carotid artery, tied simultaneously with carbolised catgut on Nov. 16. Death took place on Jan. 9. The subclavian has been laid open above and below the seat of ligature, but not at the precise point. The external coat is seen to be quite perfect, and the tube of the vessel is closed by a simple diaphragm. In the carotid this diaphragm has been cut through and the artery opened in its whole extent. Two small fissures or cracks are seen below the ligatured part, one of which (marked by a small bristle) leads into a minute cavity outside the artery, containing blood-clot. The case is reported in the 'St. George's Hospital Reports,' vol. vi., and the preparation is in the Hospital Museum.

is used, and it is not tied with sufficient tightness to completely strangle the external coat, the ligature may disappear without any division of this tissue. That this is at any rate possible is shown by a case in which the subclavian and carotid arteries were tied simultaneously with a carbolised catgut ligature, and where the patient died eight weeks afterwards from another cause. In this case the external coat was perfect in both arteries, which were closed only by a kind of diaphragm at the point tied (see fig. 18). This was the first definite anatomical proof that arteries can be obliterated at the seat of ligature without being divided, but similar cases have been since described by Mr. Treves and Mr. MacCarthy¹ and by Mr. T. R. Lane.² The use of a too absorbable ligature possesses, how-

ever, this disadvantage, that if it is absorbed before the internal coagulum is thoroughly organised, the vessel may be opened out again, and its walls, weakened by the injury and subsequent arteritis, may expand and form an aneurism. It will be seen therefore that an aseptic ligature is a matter of paramount importance in the ligation of arteries, and the old-fashioned waxed thread, which always contains a certain amount of septic matter, is universally abandoned and condemned.

The various ligatures employed in the present day are the aseptic silk, silver wire, catgut, kangaroo tendon, and ox aorta. Of these, the two first are not absorbed and remain encapsuled in the scar, the three others are absorbed. Aseptic silk is a thoroughly reliable ligature. It should be prepared by boiling in water for some time, and should be then kept in a 5 per cent.

Holmes states that he sees no motive for this return to an ancient practice; that he does not believe that the elastic tension of the artery is the main cause of secondary hæmorrhage, but ulceration going on about the ligature (the danger of which would be increased by the use of two ligatures instead of one), and that he regards the greater disturbance of the vessels involved in so free an exposure of the artery as increasing the chance of injury to the vein and so predisposing to phlebitis and gangrene.

¹ 'Med.-Chir. Proc.' vol. ix.

² 'Brit. Med. Journ.' Nov. 10, 1877.

solution of carbolic acid in oil. A convenient ligature case for private practice is made of a thick glass tube, with a silver cover screwed on, in which the ligature can be kept in the solution in the pocket for an unlimited time.

Silver wire ligatures are scarcely ever employed, they are liable to irritate the tissues and cause suppuration. Catgut ligatures were employed originally by Sir Astley Cooper, and in one case he ligatured the femoral artery for popliteal aneurism with success.¹ But he was disappointed in subsequent trials of the substance and abandoned its use. It was not until Sir J. Lister introduced *carbolicised* catgut, that it came into common use. The objection to its use is that sometimes it becomes absorbed too soon, and Sir J. Lister has more recently introduced in its place 'chromic gut,' that is to say, catgut hardened and rendered aseptic by steeping in chromic acid, which is not nearly so absorbable as the carbolicised gut, and in fact may never be absorbed, but may become encapsuled.

Kangaroo tendon ligature is made from the small tendons of the kangaroo tail, and is the form of ligature usually employed at St. George's for ligature of arteries in their continuity, and has been found to answer admirably.²

Ox aorta ligature is made of the middle coat of the aorta of an ox, and is recommended by Mr. Barwell.³ It, like the kangaroo tendon, must be rendered aseptic by long soaking in a 5 per cent. oily solution of carbolic acid.

While the closure of the artery and the changes in the ligature above described have been going on, the circulation has been re-established by the increase in size of the anastomosing vessels. That increase is in some cases very rapid, in others, as it seems, very slow. The rapidity with which it takes place has been proved by experiment on the lower animals,⁴ and by many recorded facts, which show that in man the circulation is very rapidly established, particularly in the upper extremity. Wardrop says:⁵ 'The enlargement of the anastomosing vessels to a certain extent takes place almost instantly after the trunk has been tied. I observed this in a child in whom I had secured the carotid artery. I could see the branches of the temporal and occipital arteries under the delicate integument enlarging immediately after the operation.' And instances are not wanting in which after the ligature of the main artery of a limb the pulse has been felt below the ligature in a day, or on the second day. But the anastomosing vessels continue to enlarge for a considerable period, estimated by Porta as being usually under a year. All the time during which the collateral circulation is deficient, the limb remains cold, weak, and liable to suffer from any rapid change of temperature; and even after it has attained its highest grade, the limb in which the main artery has been tied is weaker, smaller, and less vigorous than natural.

Failure of
process.
Secondary
hæmor-
rhage.

When any of the steps above described are incomplete the operation usually fails, and either secondary hæmorrhage or gangrene may result. Clinically we define secondary hæmorrhage as that which comes on any time after the first twenty-four hours after a wound, until its complete cicatrisation. The period of its occurrence varies, depending mainly upon the size of the vessel, and it is therefore later, as a rule, in those of larger

¹ The case is related in Cooper's and Travers' Surgical Essays, vol. i. p. 125.

² On the behaviour of tendon ligature, see a paper by Mr. Dent, 'Med.-Chir. Trans.' vol. lxiv. p. 231.

³ 'Med.-Chir. Trans.' vol. lxii.

⁴ Broca, 'Sur les Anévrs.' p. 507, note.

⁵ Wardrop 'On Aneurism,' p. 12.

size. Generally from the tenth to the fourteenth day, during which the ligature may be expected to separate, is the critical period as regards secondary hæmorrhage. It depends upon the obliteration of the vessel not being complete at the time the ligature separates, or perhaps more frequently from the extension of the ulceration (which is necessary for the separation of the ligature where the wound is not aseptic) beyond its proper bounds, so that it lays open a portion of the vessel not completely filled with clot. Under these latter circumstances there can be no doubt that the bleeding takes place from that portion of the artery on the distal side of the ligature. This is probably due to this part of the vessel being less sufficiently nourished from the strangulation of the vasa vasorum at the seat of ligature, and thus its proper blood supply having been cut off. The hæmorrhage usually commences gently, almost insidiously, so that the surgeon at first tries to persuade himself that it is merely a little oozing from the granulations of the wound, and this kind of secondary hæmorrhage may often be successfully treated by well-applied pressure. Pressure is best applied by graduated compresses in the wound, or by filling the wound with small-shot, which is to be firmly bandaged on, and an aneurism compressor adjusted over it; and it may be assisted by compression of the trunk above, which, if done at all, should be digital, much care being taken not to compress the vein. The limb should be carefully bandaged, and some authors recommend putting a compress of lint on the artery below the wound. But if the bleeding begin furiously, as from the upper end which has suddenly given way, or if pressure does not check it, three courses are open: to tie a higher part of the artery, to re-open the wound and place another ligature on the bleeding vessel, or to amputate. The ligature of a higher part of the artery, which used to be the orthodox treatment, almost always fails, and I quite agree with Mr. Erichsen that it only adds to the danger of the patient.¹ In a most interesting paper in the 'St. Bartholomew's Hospital Reports' (vol. x.) Mr. W. H. Cripps has shown that not only has it frequently caused death directly, but that it has usually failed to prevent the recurrence of bleeding, while yet in some of these cases a cure was obtained by the after-employment of compression. The attempt to re-tie the vessel at the seat of ligature is a dangerous and in some cases a very difficult operation; the tissues are loaded with blood, the artery is very difficult to recognise unless the bleeding is allowed to go on; and such renewed loss of blood may easily prove fatal to one weakened by previous hæmorrhage. Besides, the artery may be too rotten to bear a ligature, or the vein may easily be included with it. Furthermore, the hæmorrhage, as we have already seen, frequently comes from the distal end of the vessel, and it is sometimes impossible at the bottom of a deep sloughy wound to accurately ascertain this fact. Under these circumstances the ligature of the vessel just above the site of the former ligature would be absolutely useless.² Still the attempt has proved far more

Treatment,
of second-
ary hæmor-
rhage.

¹ On the other hand, Mr. Maunder argues that the ligature of the vessel above renders the subsequent use of compression more likely to succeed, when the bleeding is from the proximal end of the wounded artery ('Surgery of the Arteries,' p. 93). Obviously, however, the use of compression after ligature must greatly increase the risk of gangrene.

² There is in the museum of St. George's Hospital a preparation which illustrates this. It is that of a femoral artery, which was tied for popliteal aneurism and in which secondary hæmorrhage occurred. In addition to the original ligature, the artery is encircled by three other ligatures, at short distances, one above the other, and the vessel is here occluded to a very considerable extent. Below the original ligature the vessel con-

successful than the ligature higher up. Amputation is, I am persuaded, the best treatment in many cases of aneurism; since it removes a formidable disease which is by no means cured at the time when secondary hæmorrhage occurs; but no one would willingly resort to it in a case of mere wound.

The result of Mr. Cripps' inquiries is as follows. The paper includes all the cases which he could find of secondary hæmorrhage after the ligature of the femoral in its continuity for all causes, fifty-three in number. There were fourteen cases in which the external iliac was tied: twelve died, one recovered under pressure on the recurrence of hæmorrhage,¹ and one after amputation for gangrene; five others were amputated, two died, three recovered. In twelve cases the artery was re-tied: seven died, and five recovered. In fifteen cases pressure was used, and only three died. In seven cases, from various causes, no treatment was used, and three of these recovered.²

It might be argued, in explanation of the far more favourable results of pressure, that that method had only been used in the mildest cases; but Mr. Cripps says that on perusing the notes of the cases, he does not believe this to have been the fact. The perusal of the paper has certainly confirmed my previous impression, that most of the cases of secondary hæmorrhage which can be saved will be saved by the persevering use of well-applied pressure. But there are unquestionably in practice cases where secondary hæmorrhage bursts out with such violence from the upper end of the artery that it is useless to spend time on the attempt at compression. Such cases must be treated, I think, like fresh wounds of the vessel, by re-tying it; or, if the attempt to re-tie the vessel fails, by amputation. And there are other cases where the persevering use of pressure has failed. Here the surgeon must be left to choose between re-tying the vessel and amputation.

Secondary hæmorrhage in diseases.

Secondary hæmorrhage occurs not only after injuries, but also, and that very frequently, in diseases. Thus, after all forms of gangrene, secondary hæmorrhage may occur, though it is not very common, since the vessels are generally plugged around the gangrenous part. In sloughing and phagedenic ulcers, hæmorrhage takes place more frequently, though here again it is rare for the larger trunks to be opened. Hæmorrhage from ulcerating cavities, or from the granulations of a partially healed wound, the exit from which is in great part obstructed, is much more common. In the treatment of such cases of hæmorrhage, it is a matter of primary and vital importance to have the bleeding surface freely and fully exposed. Many a patient has been allowed to bleed to death while vain attempts were being made to check hæmorrhage by styptics, which would have subsided at once if the cavity had been exposed to the air by a free crucial incision. When the source of hæmorrhage is thus fairly in view, if it be a single vessel it can be secured, or if too much diseased to bear ligature or torsion, can be compressed or cauterised. Bleeding from numerous small vessels may be treated by styptics, and in a very few cases irrepressible hæmorrhage from a great trunk may be treated by the ligature of the trunk at a higher spot, or may even necessitate amputation.

tains very little clot, and it is clear that the secondary hæmorrhage was from the lower end of the artery. Series vi. p. 117*b*.

¹ In this case the surgeon in charge states his opinion that the ligature of the external iliac was a useless operation.

² In cases of secondary hæmorrhage from the stump of an amputation, the results of ligature of the artery higher up seem to have been less disastrous, but the number recorded here is very small. Three cases are referred to, in two of which the common iliac was tied after the external. All recovered.

There is another form of bleeding which is sometimes confounded with secondary hæmorrhage, though it is of quite a different nature. I mean the reactionary hæmorrhage, which sometimes comes on an hour or two after a wound, when the patient becomes warm in bed, and has recovered from the shock of the operation or accident. This depends merely on some vessel or vessels, which have not been secured, bleeding under the influence of warmth and renewed circulation. If pressure does not succeed in checking the hæmorrhage the bleeding vessels must be exposed and treated just as in primary hæmorrhage.

Reactionary or recurrent hæmorrhage.

The other main cause of failure after ligature is gangrene, and it depends usually, as it seems, on the failure of development of the collateral circulation. This, however, is by no means the only cause of gangrene, for it may be occasioned also by coagulation in the vein, the result of bruising or laceration of that vessel in the injury or in the operation, and in cases of aneurism it depends sometimes on inflammation of the sac, by which the pressure on the vein or veins is increased and the veins themselves in some cases also affected by inflammation. Gangrene from the two former causes commences early, usually within four days after the ligature; the latter cause may be several weeks in producing its effect. The treatment to be pursued depends on the rapidity with which the gangrene spreads. If it comes on over a large surface, or in several places at once and advances rapidly, no delay should be admitted, but the limb should be removed at once, the section of the artery being made as near as possible to the tied portion—not above it. If only a small part of the limb—say one or two toes—is affected, and the gangrene advances slowly, without constitutional symptoms, there is good reason to hope that mortified parts will separate and a useful limb be preserved.

Gangrene after ligature.

This view of the causes of failure of the ligature would not be complete without the mention of what, however, belongs to the subject of aneurism, and not of hæmorrhage, viz. that the collateral circulation sometimes errs from excess. When the main artery is tied in order to cure an aneurism, or when the operation is performed for general inflammation of the limb (as recommended by Dr. Campbell and Dr. Onderdonk, in America, and in this country by Mr. Maunder¹), the collaterals may enlarge so rapidly and to so great an extent as at once to reproduce the circulation below, which it was intended to suspend. The treatment of aneurisms when recurring from this cause will be spoken of in the section on that subject.

Recurrence of circulation.

We have now to say a word or two on the ligature of the cut end of an artery in an open wound. Here the pathological changes which go on are almost identical with those which follow ligature of an artery in its continuity.

Ligature of arteries in an open wound.

There is the same division of the internal and middle coats at the seat of ligature, but it is probable that the portion of the vessel beyond the ligature dies, and if the wound is maintained in an aseptic condition, is absorbed by the cells of the granulation tissue. If, on the other hand, suppuration takes place, the portion of vessel is probably thrown off as a minute slough, or is destroyed in the suppurative process. The vessel is sealed exactly in the same way by the formation of a clot, and its organisation.

Wounded vessels used in former days to be secured by driving a sharp hook, called a *tenaculum*, through the bleeding mouth of the vessel and the tissues immediately adjacent, and then tying a ligature under the convexity of the hook. The *tenaculum* being now withdrawn, the ligature of course compresses the

Method of tying arteries wounded in operation.

¹ See 'Biennial Retrospect of New Syd. Soc.' 1867-68, p. 284.

vessel a short distance from its cut end. This method, however, is somewhat rough, since a good deal more tissue is included in the ligature than is really necessary. It is, however, still often employed when the vessel lies in the midst of dense structures from which it cannot well be separated. Otherwise it is better to pick up the vessel, and separate it cleanly from the tissues around, drawing it slightly out of its sheath with one of the forms of forceps here figured. The name *tenaculum*, which used to be appropriated to the sharp hook, is now more commonly applied to the forceps used for tying arteries. Each form has its advantages. Liston's, when closed, catches with a spring which holds it on the artery, and enables the surgeon to tie the vessels more easily when he has no assistant. Assalini's may be armed beforehand with the ligature, and I think enables the surgeon and his assistants to secure the vessels in a large wound more rapidly. But the use of one or other is more a question of fashion and habit than of any essential superiority.



FIG. 19. Liston's Tenaculum (modified).

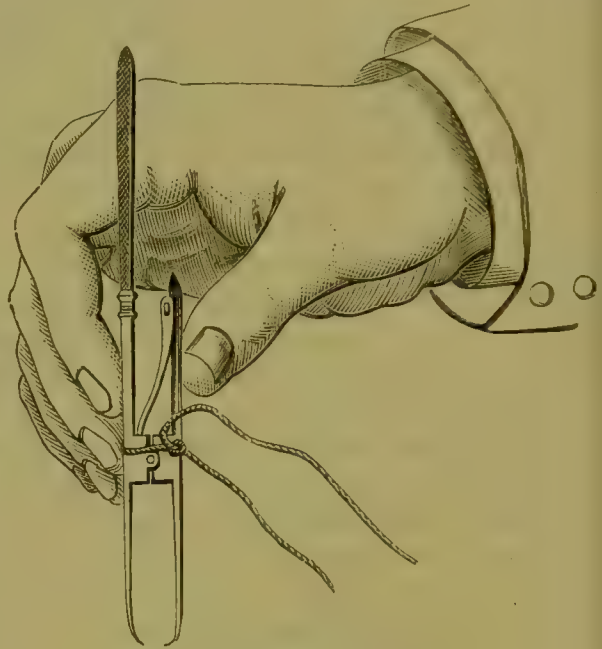


FIG. 20. Assalini's Tenaculum.

Acupres-
sure.

I have spoken in the preceding sentences of 'tying' arteries, since this is the general, and for the moment, at any rate, the most certain method of securing them. But there are two other plans which have come much into vogue of late years, viz. Acupressure and Torsion. The chief object for which these methods were introduced was to avoid that which is the drawback of the silk or hempen ligature, viz. the abiding irritation and ultimate ulceration by which the ligature is cast off. But now that aseptic ligatures are almost universally employed, the necessity for these methods is not so apparent.

The different methods of applying acupressure are reduced by Pirrie, its most ardent and considerable advocate, to three, which he has denominated Circumclulsion, Torsoclusion, and Retroclulsion. In the first method (fig. 21) a pin is passed below the divided artery, and a loop of wire, placed over the end of the pin, compresses the tissues in which the artery is lying, and is twisted tightly enough round the stalk of the pin to stop all bleeding. Then the point of the pin is passed into the tissues, while the ends of the wire hang out at the other side of the wound with the head of the pin. When the pin is withdrawn the wire of course becomes loose, and is drawn out also. In the second method (torsoclusion, or the Aberdeen twist), the

pin is passed in parallel to the vessel (fig. 22 (1)), then twisted round a quarter of a circle and driven across the vessel into the tissues on its further side tightly enough to keep it in its new position (fig. 22 (2)). In the third method, retroclusion, the pin is passed first above the artery, under a

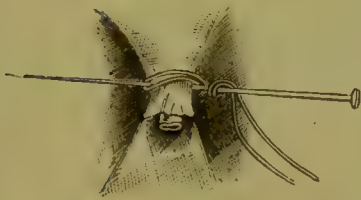


FIG. 21. Acupressure. First method, or *Circumclusion* (after Pirrie).

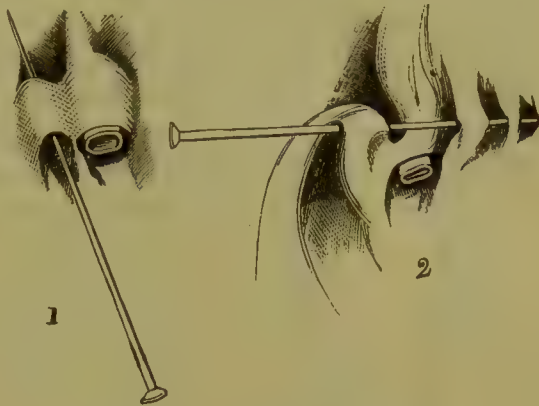


FIG. 22. Acupressure. Second method, or *Torsoclusion* (after Pirrie).

few muscular fasciculi only (fig. 23 (1)), then twisted round half a circle, and driven below the artery into the tissues on the side where it first entered (fig. 23 (2)). The pins are withdrawn as early as the surgeon thinks it safe. Dr. Pirrie gives eight hours for smaller arteries, such as the facial, temporal, radial, ulnar, mammary, and spermatic, and twenty-four hours for such as

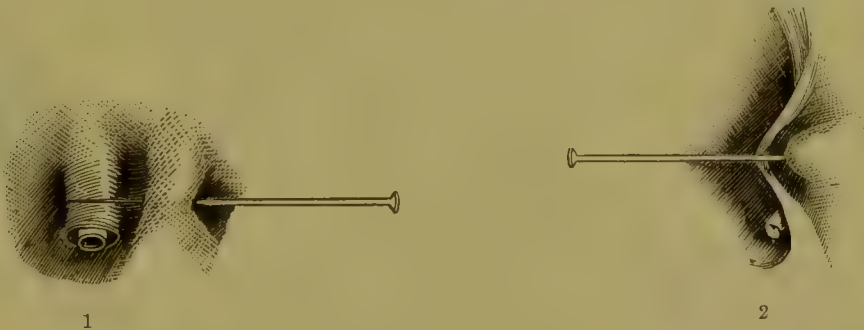


FIG. 23. Acupressure. Third method, or *Retroclusion* (altered from Pirrie).

the brachial, axillary, and femoral, as periods at which the pins may be safely withdrawn; and he intimates his belief that it will be found safe even to shorten this period.

This method of securing arteries has been but little adopted, and, since Pirrie's death, has almost fallen into disuse, except in some special cases. It is not so 'secure as the ligature, or physiologically so sound as the practice of torsion.'¹ It is still used in the operation of harelip, when, however, it is employed more as a suture than an hæmostatic, and it may sometimes be advantageously used in scalp wounds and wounds of the face.

Torsion is a very old method of stopping hæmorrhage. It was extensively used in the last generation, and the readers of Porta's great work² will know that he employed it successfully in many of the major operations; but it passed out of practice, probably in consequence of the loss of time which it sometimes occasions, and which was a very important consideration in operations per-

¹ Bryant, 'Practice of Surgery,' vol. i. p. 479.

² 'Sulle Alt. pat. delle Arterie,' published in 1845.

formed without anæsthetics. It was revived by Mr. Syme, and is now used by many of the best surgeons. The action of torsion is very easy to understand. If the divided end of a large artery be taken hold of with a pair of forceps (fig. 24), all other tissues being carefully avoided, and twisted round four or five times till its coats are felt to give way, it will be found on laying it open that its internal coat has been torn, and the middle coat has also been separated from the external, torn, and twisted up into the tube of the vessel, which is therefore closed by a firm plug, while the external coat remains uninjured, though more or less twisted (fig. 25). Even in the dead subject the vessel is so firmly closed that no fluid can be forced through it.



FIG. 24. Torsion-forceps. The artery to be twisted being caught between the blades of the forceps, they are closed as far as the thickness of the tissue embraced by them will allow, and the catch on the upper blade is then pushed down as far as it will go. The wedge-shaped projection from the lower blade enables the catch to hold the forceps firmly closed, whatever may be the distance between the blades. This is one of the most convenient and efficient of the many forms of catch-forceps for torsion.

In a large wound, such as that of an amputation, when all the divided arteries have been thus treated, the wound is left entirely without any foreign body. It is true that the twisted ends of the vessels may slough and come away, but it seems certain that this is exceptional in skilful hands.

Torsion is not easy to perform successfully, and this difficulty is felt even more with the smaller arteries than the larger ones. This depends on the difficulty of isolating the latter from the tissues around, especially while they are bleeding; and it is on this proper isolation that the prompt success of torsion in stopping bleeding depends. A large artery can be easily drawn out of its sheath, and then two methods of twisting it are employed, called *limited* and *free* torsion. In the former the artery is drawn out of its sheath, seized with forceps about an inch above the divided end, and then twisted with a second pair of forceps so that only the part between the two pairs of forceps is twisted;



FIG. 25. Torsion. Taken from a large artery which was removed from the body before it was twisted. The internal and middle coats are seen to be separated from the external, and pushed up the tube of the artery like a plug.

in the latter it is merely drawn out and twisted freely. Small vessels can, of course, hardly be twisted in any other than the latter way.

With regard to the comparative value of these methods of arresting hæmorrhage, it would appear to me that acupressure is far inferior to either of the others. Its success depends upon the temporary clotting of the blood in the vessel up to the first collateral branch, and no means are taken to retain this clot until permanent sealing takes place. Theoretically, therefore, it is easy to understand, that the clot might be displaced by the pressure of the blood behind it, and thus hæmorrhage occur. Moreover, if a great number of vessels require to be secured, the mass of pins and wire loops renders acupressure very inconvenient. With regard to ligature and

torsion, they are both perfectly reliable methods of arresting hæmorrhage. The experience of the surgeons at Guy's Hospital, where two hundred consecutive cases of amputation have been performed, in all of which the arteries have been twisted, without a single instance of secondary hæmorrhage, is sufficient proof of the value of torsion as a hæmostatic.¹ The only thing that can be said against it is that it is a very tedious business even in the hands of those most versed in it. At the same time the carbolised ligature is so reliable, so perfectly easy to apply, holds the artery firmly closed, and does not interfere in any degree with primary union, that it seems to me we have in it the most perfect means of securing arteries. And I should, personally, have greater confidence in leaving a patient, not under my immediate eye, with his vessels properly tied, than if I had applied torsion.

There are cases in which a considerable artery is wounded, yet where it can neither be tied, compressed, nor twisted. In some such cases, as before stated, it is justifiable to tie the artery or arteries higher up, as is often done in wounds of the palm. Yet it must be allowed that the practice is an uncertain one, and has often led to loss of limb or life. No doubt in many such cases more accurate pressure would have been successful. Professor Vanzetti has lately proposed for such cases a plan which he calls 'uncipression,' and which I think is well worthy of a trial. A pair of sharp hooks, double or single, according to circumstances, are dug into the two sides of the wound, so as to make pressure on the bleeding point or points, and these hooks are fixed by an elastic band to a splint on which the limb rests, or to something at the side of the bed. The hooks may be mounted on handles or on a chain, like the ordinary dissecting-hooks. See 'Medical Record,' March 3, 1875, where another plan of applying compression may also be seen described by M. Verneuil under the name of 'forcipression,' which consists simply in embracing the bleeding point or points in the blades of a catch-forceps or ordinary dressing-forceps, tying the blades of the forceps together if necessary, and leaving them in the wound till they drop off, or till the surgeon thinks it safe to remove the instrument. And this, or something like it, is often done after amputation. Obstinate bleeding from a point which cannot be fairly brought into view, or where the tissues are too rotten to bear a ligature, may frequently be suppressed by taking up all the tissues around with a tenaculum or sharp hook, under which a common or an elastic ligature is passed, and which is left in the wound for a day or two, or allowed to fall off by itself.

Other means for arresting hæmorrhage; unci- and forcipression.

Such are the surgical means for combating those formidable attacks of hæmorrhage which result from injury to the larger vessels. But the common hæmorrhage which proceeds from small arteries or capillaries and veins, when it does not cease of itself, as in the great majority of cases it does, is usually treated by one of four methods—pressure, cold, heat, or styptic applications—and sometimes by a combination of them.

Capillary hæmorrhage. Pressure; cold; heat; styptics.

Pressure is the most effectual hæmostatic when it can be applied evenly over the whole wounded surface; in fact, we have seen above how potent it is in repressing hæmorrhage even from the femoral artery after ligature. In some cases pressure can only be applied with the finger. Thus, in a case under Sir B. Brodie's care, where the internal pudic artery had been wounded inside the ramus of the ischium, pressure was made by a relay of students

¹ 'Practice of Surgery,' Bryant, vol. i. p. 480.

for forty-eight hours successfully. But ordinarily pressure is made, as directed on p. 103, with graduated compresses, kept in position by strapping, and assisted if need be by a horse-shoe tourniquet. The limb in all cases should first be evenly and firmly bandaged.

Cold is usually applied by exposing the part to the air, as in opening bleeding abscesses (see p. 41), or in operations where a good deal of oozing is going on and cannot be repressed. In such cases the operator passes his sutures through the edges, but does not tie them, and leaves the part exposed to the air for a few hours, when any clot which has collected may be gently removed and the stitches drawn together. The application of ice in a bladder to the wound, and the irrigation of the wound with iced water, are also powerful hæmostatics.

Heat is a most useful means of arresting hæmorrhage, especially general oozing after an operation. It acts in the same way as cold by causing a contraction of the muscular coats of the arteries. Water at a temperature of 130° F. to 160° F. should be used, to which some antiseptic, corrosive sublimate, carbolic acid, &c., may be added. If the temperature is below this, the bleeding is increased, because it relaxes the blood-vessels; and if a higher temperature than 160° F. is employed, it causes injury to the tissues.

Of styptics the one in most use at present as a local application to wounds is the perchloride of iron. Lint steeped in the Tinct. Ferri Perchlor. is laid on the bleeding surface and gently pressed into it. Another very useful styptic, especially when it is desired to produce a superficial slough as well as to stop bleeding, is *blue lint*, i.e. lint which has been steeped in a saturated solution of sulphate of copper, and is kept at hand dry for use. Matico leaves are often used with success to fill bleeding cavities, such as those of cancerous ulcers.

Finally, the most powerful of all styptics is the actual cautery lightly used at a white heat. The shape and size of the cauteries should be adapted to the surface to which they are to be applied, so that a good many ought to be at hand at once. By far the best cautery, when it is not necessary to apply the heat to a very large surface, is the newly invented 'Benzoline cautery,' in which any required degree of heat can be produced in a moment. They should not be used too cool, otherwise the tissues are apt to stick to them, nor be pressed too hard or too long on the bleeding surface, for the same reason. If the charred tissue sticks to the cautery the parts will be torn in dragging it away, and the bleeding will most likely recur. Many surgeons think that this adherence of the tissues is less probable when the cautery is heated only to a dull red; but whatever be the method of applying the cautery, the surgeon should not be contented till he has seen that every point from which free bleeding came has been perfectly and completely charred, and then the tissue may even be returned into the interior of the body (as in piles or ovariectomy), with full security against recurrent hæmorrhage. Nor is secondary hæmorrhage at all common on the falling of the slough.

Styptics are of use chiefly in bleeding from cavities, where the ordinary means cannot be employed, or in bleeding from ulcerated tumours. The principal objection to their use is that they prevent primary union by interfering injuriously with the character of the wound.

The actual cautery is also used extensively as a counter-irritant, as will be pointed out in the chapter on MINOR SURGERY.

In some cases of the most extreme exhaustion from hæmorrhage the patient has been rescued from death by injecting blood into the veins. This blood is taken instantly before injection from the arm of a healthy person.¹ There are two chief methods of transfusion—the indirect and the direct, or immediate. In the latter the blood is passed directly from the arm of the person who furnishes the blood into that of the patient; while in indirect transfusion the blood is received into a vessel, and may be defibrinated before it is injected into the patient's vein.

Transfu-
sion of
blood.

The operation is not a difficult one, if the patient's veins are well-marked. A free incision is to be made over the largest of the veins at the bend of the elbow, so as to expose it; it is then opened with a V-shaped cut of the scissors, and the nozzle of the syringe inserted. This nozzle should be warmed to the temperature of the body and filled with warm water. Then the blood is procured as rapidly as possible from a healthy man, whose vein is opened in a similar way. If the immediate method is followed, after Dr. Aveling's plan, the nozzles of the two syringes are connected by a warmed

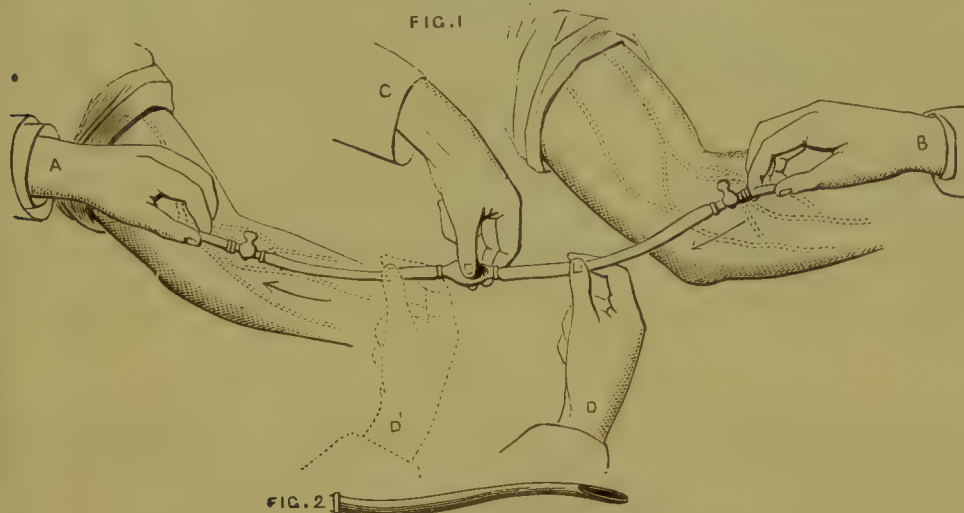


FIG. 26. Aveling's apparatus for immediate or direct transfusion. The more muscular arm on the right of the figure is the blood-giver's; the one on the left the patient's. The course of the veins is dotted down, as if the skin were transparent. B represents the hand of an assistant holding the efferent tube and the lips of the small wound together, and A shows the afferent tube secured in the same manner. The bevelled end of the afferent tube, which is made so in order that it may the more easily go into the collapsed vein of the patient, is shown in fig. 2. The nozzles having been secured in the two veins, the india-rubber portion of the apparatus, filled with water, and kept so by turning the cocks at each end of it, is now fitted into the tubes. Then the cocks are turned and the operation commenced by compressing the india-rubber tube on the efferent side, D, and squeezing the bulb C. This forces 3ij. of water into the patient's vein. Next shift the hand D to D', and compress the tube on the afferent side. The bulb will expand slowly and draw blood in from the blood-giver's vein, which is then to be passed into the patient's; and by repeating this manœuvre as often as required any amount of blood may be injected, so long as the tube is not clogged by coagulum. See 'Obstetric Soc.'s Trans.' vol. vi. May 4, 1874.

tube, in the middle of which there is an elastic bulb, the capacity of which should be accurately known. The nozzles being inserted in the two veins, in the course of the circulation, the tube is fixed on to the nozzle in the blood-giver's arm, and the operation proceeds as described. The blood is injected by successive discharges of the bulb, until about 6 ozs. has been passed in. It is not generally considered necessary or desirable to inject a larger quantity at once.

Mons. Roussel has invented an apparatus for transfusion, which appears to

¹ In America lamb's blood seems to have been transfused in cases of consumption, and more recently the intra-venous injection of milk in small quantities has been recommended in cases of 'cholera-enteric fever,' phthisis, and pernicious anæmia, as a substitute for the transfusion of blood. See a paper by Mr. Jennings, 'Brit. Med. Journ.' June 6, 1885, where the experimental and clinical experience on this subject is summarised.

reduce the dangers of the operation to a minimum. But it is a costly and elaborate appliance, requires constant practice to use it with success, and is very liable to get out of order ; it is therefore never likely to come into common use.¹

For indirect, or mediate, transfusion, the best plan is that introduced by Mr. J. M. Cotterill.² Forty-eight grains of phosphate of soda are dissolved in two ounces of hot distilled water. To this is added six ounces of blood, and the mixture kept as nearly as possible at a temperature of 100° F. by immersing the vessel in which it is contained in a basin of boiling water. The mixture is then injected into a vein of the patient with a syringe previously washed in the same soda solution and kept warm by being wrapped in a hot flannel. This plan is probably the best means of transfusion, and the one which should usually be adopted. In a case recently, in which I had the advantage of seeing my colleague, Mr. Haward, perform this little operation, it answered admirably, and we have had two or three other cases lately at St. George's, which have been equally successful.

Dr. Duncan of Edinburgh³ has lately practised transfusion of blood in primary and other amputations involving risk of death by collapse, in order to return to the system the blood lost in the operation. A five per cent. solution of phosphate of soda is employed to keep the blood fluid. In amputation, a short glass tube, of the size of a No. 6 catheter, with a pen point is introduced into the main vein of the limb and temporarily secured with a piece of carbolised catgut. A graduated glass vessel kept in hot water contains the solution and receives the blood. The latter must of course be perfectly free from pus, or any other morbid product. An assistant slowly injects the fluid while the surgeon is securing the vessels.

COLLAPSE.

Collapse, or shock, may be described as a depression or lowered vitality produced by some violent stimulation of the peripheral nerves, or some powerful impression applied to the nerve centres. It may, therefore, be produced, in the first instance, by severe injuries—burns and scalds, crushing of a limb, capital operations, laceration of one of the viscera, &c., and is usually most severe when the injury affects those parts richly supplied with sensory nerves. Shock may also be produced from the impression made on the peripheral nerve-endings by the sudden withdrawal of pressure, as in the case of an over-distended bladder. The sudden removal of the urine, and the impression thus produced on the nerves of the bladder, may produce a very considerable amount of shock. Secondly, a powerful impression made on the central organs of the nervous system produces shock. Thus, mental emotions—sudden fright, anger, joy, pain, and loss of blood—all produce symptoms of shock in this way.

The amount of shock varies under different circumstances. Thus, age has some influence upon it. Children, as a rule, bear operations and injuries well, and suffer little from shock, unless the injury is attended with much loss of blood. Old people, on the other hand, especially if there is disease of any important organ, bear operations and injuries badly, and the shock is very often severe. Visceral disease always increases it, and it is especially great in the neurotic or excitable individual. Under certain circumstances

¹ For a description of it the reader is referred to Roussel's monograph 'On the Transfusion of Blood,' London, 1877.

² 'Lancet,' June 18, 1887.

³ 'Brit. Med. Journal,' Jan. 30, 1886.

shock may be delayed; if, for instance, the mind is excited or attentively occupied at the time of the injury, as in a railway collision, or on the battle-field, the shock may not come on till some time after. In shock the impression made on the central nervous system either directly or indirectly through the peripheral nerves, induces a reflex inhibition of all the functions connected with it. Thus the action of the heart is impaired, the breathing is shallow, the various senses are more or less affected, and there is partial or complete cessation of muscular action.

In severe shock the patient lies motionless, but not usually unconscious. Symptoms. The intellect is blunted, and the patient drowsy and bewildered. The skin is cold and clammy, and there is a striking pallor of the whole surface. The features are contracted and shrunk. The heart's action is increased in frequency, but diminished in power, and irregular, so that sometimes the pulse is scarcely perceptible. The respiration is shallow, irregular, and quickened, inspiration being performed in quick, short gasps. The speech is slow and feeble, and the patient appears to be unable to think or reflect. There is giddiness, with dimness of vision, and a humming noise in the ears. The temperature is subnormal. There is frequently nausea and vomiting. Muscular debility is extreme, and the contractility of the sphincters may be lost.

In such a condition as this the patient may die within a short period of the receipt of the accident, or the symptoms may be prolonged for several days, the patient never rallying up to the time of his death. On the other hand, reaction may take place.

From this extreme condition of collapse there are all possible gradations, down to a mere transient impression on the heart, pulse, and sensorium, such as is familiar to every one who has received a severe blow or felt any great emotion. The immediate symptoms of collapse are followed by reaction, and in this stage the surgeon founds his prognosis mainly upon the rapidity of the recovery, and on the character of the pulse when reaction is established. Cases in which the patient hovers long between life and death, and in which the pulse when restored is weak, rapid, and excitable ('prostration with excitement,' as Travers designated it), are very unfavourable; whilst those in which the patient, after transient collapse, recovers his senses rapidly, and in which the pulse becomes gradually more and more firm and regular, will probably terminate in recovery.

The treatment of collapse is naturally divided into two parts—the avoidance of immediate death in the first shock, and the treatment directed to carrying the patient through the subsequent reaction. Treatment.

The first care of the surgeon when called to a case of collapse is to save the patient from the danger of instant death. For this purpose warmth is one of the most essential requisites, and especially applied to the head; towels wrung out of hot water should be bound round the head, or hot affusion sedulously employed, together with heat to the epigastrium and the extremities, while the other means of supporting animation are in practice. Galvanism over the præcordial region is a most efficacious measure. Small quantities of brandy are to be given by the mouth if the patient can swallow, and by the rectum if he cannot, and ammonia is to be applied to the nostrils. The subcutaneous injection of ether (ʒi.—ʒij.) is a powerful restorative. If the heart is acting, but the patient seems otherwise dead, transfusion is clearly indicated. The efforts at revival should not be hastily given up—recovery after long seeming death is not by any means rare.

When the danger of instant death is over the patient has still to be kept alive. As soon as he can bear it, small and repeated doses of concentrated fluid nutriment should be given by the mouth, being preceded by similar nourishment given per rectum in such quantity as will not provoke an action of the bowel, and the supply of alcohol should be gradually withdrawn as early as is found to be possible. When reaction is not established, but 'prostration with excitement' is manifested, opiates must be administered to procure sleep, the warmth of the body and extremities must be maintained, the irritability of the stomach must be lessened by the application of mustard poultices, by sucking small morsels of ice constantly, and by the administration of dilute hydrocyanic acid or creasote. At the same time both food and stimulants must be supplied in small quantities, and in such a way as can be best assimilated by the patient.

Operations
in collapse.
Anæsthe-
tics.

Many of the patients whom we see in the hospital practice of large cities are collapsed from grievous injuries which must call ultimately for severe operations if the patient is to have any prospect of life. In such cases the question first occurs whether to operate at once, or to postpone the operation till the patient has somewhat rallied, and with this is connected the question whether anæsthetics are desirable. I have seen operations performed in conditions of extreme collapse, without any manifestation of pain on the patient's part, or any apparent increase of the shock; but when the operation is a severe one, such as a large amputation, it is better, I think, to give an anæsthetic; nor is anæsthesia under these circumstances attended with danger. I have often seen the pulse improve as the patient came under the influence of the anæsthetic. Ether is preferable to chloroform in these cases, and it is well, if the patient can swallow, to give him a little alcohol first. Such operations are rarely attended with any danger from hæmorrhage, and I think are best performed as soon as the surgeon believes that the patient can live through them.

CHAPTER V.

BURNS AND SCALDS.

BURNS and scalds are the most commonly fatal of all injuries, especially in cold climates, and among the poor, whose children are frequently left for long periods in the neighbourhood of fires and kettles with no proper attendance. Scalds are, as a rule, less fatal than burns, since the hot liquid is soon shaken off the body, and itself soon cools; but there are accidents somewhat resembling scalds, produced by the contact of molten metal, which are even more fatal than an ordinary burn, because the molten mass adheres to the charred parts and retains its heat for a long period.

The fatality of burns varies according to their extent, their depth, the part burnt, and the age of the patient, besides a number of other miscellaneous circumstances. The classification of burns according to their depth, which is usually followed, is that proposed long ago by Dupuytren, and it is no doubt a very useful and practical one, though it only indicates the depth of the burn at its deepest part; and it must be recollected that a large superficial burn may be even more dangerous than a small deep one, particularly if the latter is situated on an unimportant part. But deep burns must be followed by cicatrisation and deformity, which is not the case where the whole of the thickness of the skin is not destroyed.

Dupuy-
tren's clas-
sification of
burns.

The *first* degree of burns is a mere scorch, where only superficial redness is produced but the epidermis is not separated from the true skin. The scorched epidermis may desquamate afterwards, but beyond a little temporary discolouration no trace of the injury will remain.

In the *second* degree the epidermis is raised up from the cutis in blisters or bullæ, which are produced by the effusion of serum from the vessels of the papillæ, showing that the cutis itself is scorched. If the epidermis is dragged off accidentally, as happens often in removing the clothes, this scorched part of the skin will inflame, and an angry sore will result.

In the *third* degree the cutis is not only scorched but is disorganised by the burn, though not in its whole thickness. A part of the skin (viz. the papillæ, and a portion of the thickness of the corium) is charred and dead, and this part must separate as a slough, exposing a granulating surface of cutis below, which heals by cicatrisation, but without any contraction, since the deeper layer of the skin which is not destroyed maintains the shape of the parts.

In the *fourth* degree the whole skin is burnt, and the subcutaneous tissue of course shares to some extent in the destruction; consequently, the cicatrisation which follows on the separation of the eschar must involve a very strong tendency to contraction, as the elastic cellular tissue is replaced by the inelastic contractile scar.

In the *fifth* degree the destruction extends below the fascia, and the muscles and other subjacent parts are burnt to a variable depth.

In the *sixth* degree the whole of the limb is charred and consumed down to the bone.

Thus the first and second degrees of burns involve no necessary

deformity, the third only a scar, which remains during life, but without any change in the shape of the parts; while the deeper burns are accompanied by a tendency to contraction and deformity which can only be averted by very great care in applying extension and counter-extension while the surface is healing, and as this is frequently impossible (since the part where counter-extension should be applied may itself be burnt), deformity often ensues, and that to a very lamentable degree.

Symptoms
and stages
of burns.

Burns are attended with great pain; and when they are more than mere local injuries they are followed by prostration or total collapse, the temperature falls, the pulse becomes small or imperceptible, the tongue and mouth are dry; the patient is delirious, and rigors take place in the severer cases. This is the first stage, or that of collapse, prostration, or congestion; and in this stage many cases prove fatal, particularly in early childhood, death being sometimes preceded by convulsions. No post-mortem appearances will be found, except congestion of various viscera, particularly the brain—the result apparently of revulsion of the blood from the surface.

The next stage is that of reaction or of inflammation. It may be said (very roughly) to follow the first after an interval of about two days. The burnt surface begins to suppurate, usually with a very offensive odour, the pulse rises in force and frequency, and there may be some amount of general fever. The various internal inflammations which may be set up by the proximity of the burn to the great cavities of the body now begin to declare themselves, pleurisy and peritonitis being the most frequent. The signs of such internal inflammation are usually obscure at first, especially as physical examination is generally impossible. Disturbances of the digestive system, such as constipation, followed by diarrhœa or obstinate vomiting, are common in this stage of burns.¹ These symptoms may be caused by incipient peritonitis, or, as it seems, by the foulness of the discharge. As the sloughs separate, hæmorrhage may take place, but it is very rare. In fatal cases various inflammatory appearances are found, chiefly of the thoracic and abdominal viscera, for the brain is rarely inflamed in burns even of the scalp. Amongst these must be noted the inflammation and ulceration of the mucous membrane of the intestines which sometimes takes place. It is usually limited to the duodenum, though the stomach, or the rest of the small intestine, may be also affected, or may even be ulcerated in cases in which the duodenum is intact. The subject of ulceration of the duodenum will be resumed with the third period, in which it is perhaps most common.

The third period, that of suppuration and exhaustion, is held to commence about a fortnight after the accident, or else is said to begin after the sloughs have separated. The acute symptoms which may have followed the injury will have subsided, but chronic inflammation is not by any means uncommon, and is often the chief cause of death. The patient becomes gradually weaker and weaker, and in this stage he often succumbs, perhaps after exhausting diarrhœa, which is sometimes accompanied by blood in the motions. Post-mortem examination may show no definite visceral lesion, or low inflammation of the lungs, pleura, peritoneum, or intestines may have been present. The duodenum may be found ulcerated; and in this, as in every other injury, pyæmia or erysipelas may be the direct cause of death; but neither is re-

¹ Dr. Morton, in the American reprint of the 2nd ed. of the 'System of Surgery,' says that congestion of the kidneys and albumen in the urine almost always occur as soon as reaction sets in and the temperature rises above 101° F.

lately common in burns. Tetanus, again, sometimes follows the irritation of a burn.

The ulceration of the duodenum is a singular and hitherto unexplained sequela of burns.¹ As stated above, the ulcerative action is not absolutely limited to the duodenum, but the instances of its occurrence in other parts of the intestine are purely exceptional. It is not necessarily fatal, for cicatrised ulcers have been found in the duodenum where death has occurred from other causes.² It occurs at different periods after the burn, the earliest hitherto recorded being four days; but it is rarely so early, and is more common after than before the first fortnight. It occurs after burns of the extremities as well as those of the chest and abdomen. It is found in a tolerably large proportion of fatal cases (in 125 post-mortem examinations 16 presented this lesion), and may very possibly be present in many of those which recover. The lesion is not known to be accompanied by any definite symptoms in its early stage. Pain on pressure near the pit of the stomach, and diarrhœa, with blood in the motions, naturally arouse a suspicion of this ulceration, and vomiting is not unlikely to be an accompaniment of it; but there are many other ways in which pain and tenderness of the stomach, vomiting and diarrhœa, may occur

Ulceration
of the duo-
denum in
burns.



FIG. 27. Ulceration of the duodenum in a burn, causing death by hæmorrhage from a large branch of the pancreatico-duodenalis artery. *a.* The pylorus. *b.* The ulcer on the duodenum, close below the pylorus. *c.* *d.* Bristles passed through the artery and vein, which are seen to open freely on the ulcer.—From 'Syst. of Surg.' vol. i. p. 395, 3rd ed.

in burns, and even some blood may be passed in the motions without any breach of surface; obstinate diarrhœa, however, and copious loss of blood would point strongly to ulceration. When the lesion proves fatal it is either by hæmorrhage or by perforation through the coats of the bowel into the peritoneal cavity. The accompanying illustration shows a large artery, the pancreatico-duodenalis superior, laid open by an ulcer of this kind; and our museums contain plenty of specimens of perforation. The ulcer is generally single, cleanly punched out of the mucous membrane, and situated close to the pylorus.

I have purposely abstained here from any reference to a very common cause of death in burns and scalds—viz. the injury which is so often done to the larynx by inhaling flame, steam, or hot fluid—thinking it better to treat the subject along with the other injuries of the air-passages (see the chapter on INJURIES OF THE NECK); but the subject is one which should

Burn and
scald of the
larynx.

never be absent from the surgeon's mind. The mouth and pharynx should be closely inspected, if it can be done without difficulty, in every case where the burn or scald is at all near the lips. If this cannot be managed without too much disturbance to the patient, a good idea of the immunity or implication of the interior of the mouth will be obtained by watching the patient swallowing and breathing, and every precaution should be taken to have help promptly at hand in any case which may be likely to require tracheotomy.

¹ The explanation which is usually accepted is that the circulation in patches of the mucous membrane becomes arrested, as a result of the intense congestion of the duodenum and the presence of a certain degree of septic poison in the blood, and that this area of thrombosis becomes digested by the acid gastric juice. In support of this it is argued that duodenal ulcers are generally found near the pylorus and very rarely below the entrance of the bile-duct, where the acid chyme is neutralised by the alkaline bile.

² 'Syst. of Surg.' 3rd ed. vol. i. p. 395.

If the mouth be much burnt it may be right to feed the patient through the nose, and to eke out the support and stimulants which can be given through the pharynx by nutrient injections into the rectum.

Local
treatment.

The treatment of burns is directed—1. To the immediate lesion; and, 2, to its after-consequences. At the time of the accident the main indications are to exclude the air from the burnt surface, to allay pain by opiates, and to give stimulants in such quantities as may be necessary. The applications which are in use for burns are too numerous to mention, and the choice of one or other of them will depend in a great measure on the depth of the burn. A mere superficial scorch is best treated by some warm lotion applied on a thick rag and kept constantly moist. Goulard-water with a little laudanum is perhaps as grateful as anything. Painting the surface with ink soon relieves the pain of a small superficial burn, or covering it with whitewash or some other similar substance which will crust over it and completely exclude the air from it. Common flour thickly dredged on the part is a very good and handy application. But such crusts should not be applied over burnt surfaces of the second degree, since their removal would soon become necessary, and this would drag off the epidermis. The bullæ should be pricked, the epidermis gently smoothed down, and some simple ointment put next the skin or some oily substance which will not stick when it is necessary to change it. A very favourite application to these burns and to others of greater depth is the Carron oil, made by mixing lime-water and linseed-oil in equal parts, and deriving its name from its having come into extensive use at the great Carron Foundry in the numerous burns occurring there. Oil of turpentine is a very good application to those in which the surface of the skin is quite destroyed. But for the first few days I doubt whether anything is better than simply swathing the part in thick layers of cotton-wool, which is prevented from sticking to the burnt surface by some simple ointment spread on thin soft linen or cambric, and covering the whole burnt surface. When after a few days the discharge becomes foul, this dressing should be changed for some deodorising or antiseptic oily application, or the latter may be used from the first; but all the antiseptics I have yet seen used have been stimulating, and for the first few days it is desirable, I think, to avoid any local stimulation. The carbolised oil answers every indication better than any other substance which I know of, but it should not be used too strong; for it may both prove too stimulating, and thus increase the discharge, and it may be absorbed, producing a black condition of the urine¹ and other symptoms of incipient poisoning. It is well, then, to begin with a very weak solution (about 1 to 12), and if this does not correct the fœtor its strength may be gradually increased, or a stronger solution of carbolic acid may be placed over the dressings. If carbolic acid is not tolerated, some preparation of benzoin or Condy's solution, or the Lot. Sodæ Chlorinatæ, may be applied either directly to the burnt surface or over the dressings. As the sloughs separate they should be removed at once, and any part of the slough which hangs loose should be cut away, so that the fœtor may be diminished as soon and as much as possible. It is, in fact, to the foul air which fills the sick-room that many surgeons, with much reason, attribute a great share in producing the mortality of the latter stage of burns. It keeps the patient in a low condition, destroys his appetite, and very probably keeps up or produces diarrhœa. And in hospitals it often poisons the whole air, not only of the ward itself, but of

¹ See 'St. George's Hospital Reports,' vol. vi. p. 98.

all the parts of the house which communicate with it. Hence the importance of remedying it in all possible ways. So long as there are offensive burns in a sick chamber or hospital ward the atmosphere may be partially sweetened by carbolic acid, by burning cascarilla bark, or by exposing chips of iodine, or by diffusing Condry's solution or other deodorising fluids in the pulverised condition about the room, but it cannot be doubted that some mephitic gases will still remain uncorrected. After all sloughs have come away the patient has still to undergo all the troubles incident to a long cicatrisation and often the filling up of a deep cavity. The greatest care should now be bestowed to keep the parts in such a position as to obviate contraction if possible; and the recent happy invention of skin-grafting has provided us with a means of hastening the process of healing when tardy, and of providing the materials of a scar when the surface is too extensive to fill up naturally, which is of the greatest utility in burns (see the section on SKIN-GRAFTING).

At the time of the accident opium should be liberally given to adults, and even in the case of children it is usually necessary, though more caution should be used; or it may be thought desirable to administer chloroform for the removal of the clothes and the first dressing, and to keep up partial insensibility by injecting morphia subcutaneously before the patient has quite recovered from the anæsthesia. Stimulants must also be given if there is much collapse, but they should not be poured down indiscriminately, for the administration of an excessive quantity of alcohol is always followed by reaction and renewed prostration; the pulse must be carefully watched, and only so much brandy or wine given as is required to keep it at a moderate rate and strength. If the patient can take food in good quantity this is a better source of warmth and power, and the power of assimilating food affords a good augury of recovery. If the patient be a child convulsions are to be dreaded, and are a frequent cause of death. They appear to depend on, or to be connected with, congestion of the brain, and are therefore better treated by warmth to the surface than by any other plan. The warm bath being here inadmissible, warm affusion to the head, or cloths wrung out of hot water, should be tried. Diarrhœa must be treated by opium, or by calomel and opium, or by a starch and laudanum enema, the air being changed as often as possible, if foul. Vomiting is to be controlled if possible by prussic acid or by creasote. It is, however, of the last importance in severe cases of burns not to exhaust the patient's strength needlessly by too frequent changes of dressing, and this is still more important in childhood, when terror and screaming add to the exhaustion which is necessarily caused by the pain and the change of posture, besides probably causing some bleeding from the granulations. So that burns ought never to be dressed too frequently; and the surgeon has often great difficulty in steering his way between these contrary indications, since if he puts off the renewal of the dressing too long the foulness of the atmosphere becomes a source of danger.

General
treatment.

Finally, it may become a question in some cases whether amputation is desirable. This question occurs commonly only in the case of single fingers or toes, or of parts of the foot. It is but rarely that anything is gained by amputation, for the parts around the burn for some distance are sure to be more or less injured and prone to inflammation, so that the surgeon could not get materials for a healthy stump without going too high above the seat of injury; and burns so severe as to disintegrate a large portion of the limb are attended with an amount of prostration which forbids amputation, at least at the time. After the patient has rallied the surgeon may think it better to

Amputa-
tion in
burns.

relieve him of a member which can only be a useless incumbrance, but such cases must be conducted on the same general principles as those which are applicable to secondary amputation for other kinds of injury.

Plastic
operations.

When recovery has been completed and the surface has cicatrised, great deformity is often left, requiring plastic operation, or gradual extension, or some other proceeding by which the parts may be restored to their normal appearance and function as far as may be possible. But I think it better to reserve this topic for discussion, under the head of PLASTIC SURGERY, in a future chapter.

LIGHTNING-STROKE.

A stroke of lightning produces injuries which are the combined effect of electric shock, mechanical concussion, and burn. The symptoms vary from instant death to a very trivial amount of shock. The effects are very various. The surface of the body may be burnt more or less severely; ¹ it may, as is said, be marked by arborescent lines, which are believed to be in a sort of way photographed from neighbouring trees or other objects; the hairs may be removed or fall out soon afterwards; the special senses, especially that of sight, may be more or less impaired or even totally destroyed; the other functions of the brain may be variously affected, sometimes to the extent of total paralysis; and other less definite and less certain effects have been described.

In cases of sudden death from lightning it appears that the muscles are usually made rigid at once, though this rigor is sometimes so transient that some writers, notably John Hunter, teach that there is no rigor mortis in such cases; but the amount and duration of rigor vary. In some cases there is excessive and long-continued stiffness, the blood is often uncoagulated, and the heart flaccid and empty.

The indications for surgical treatment in cases of apparent death from lightning are thus given by Brodie: ² 'Expose the body to a moderate warmth, so as to prevent the loss of animal heat, to which it is always liable when the functions of the brain are suspended or impaired; and inflate the lungs, so as to imitate the natural respiration as nearly as possible.'

The minor injuries must be treated on general principles. Galvanism appears the most appropriate remedy for any partial loss of cerebral power, and should be used in a mild form for a very long time, combined with small doses of strychnia and other tonics. It has often been noticed that success has attended this treatment, when long persevered in, even in cases where the special senses had at first been very seriously impaired.

¹ A very singular case is described in 'Clin. Soc. Trans.' vol. xiii. p. 32, by Mr. Wilks, of Ashford, in which a man was literally stripped naked (except one sleeve of his flannel waistcoat) by a flash of lightning, which also burned and otherwise injured him. He ultimately recovered. The post-mortem appearances in a case of fatal electric shock are elaborately described by Mr. Sheild and Dr. Delépine in the 'Brit. Med. Journ.' March 14, 1885.

² Works, edited by Charles Hawkins, vol. i. p. 442.

CHAPTER VI.

GENERAL PATHOLOGY OF FRACTURES AND DISLOCATIONS, INCLUDING
THE PROCESS OF UNION IN HARD PARTS.

FRACTURES.

A FRACTURE is defined as being a sudden and violent solution of continuity in a bone. The force which produces it (its immediate cause) is generally external, though in some cases muscular action causes fracture. Occasionally disease of the bones acts as a predisposing cause of fracture, such diseases being rickets, senile atrophy, cancer, mollities ossium, necrosis, strumous or syphilitic inflammation, and locomotor ataxy according to Charcot.¹

Fractures occur at all periods of life, but are of course more common at the periods of greatest activity, and in the male sex. They occur even within the uterus, whether from external violence, as from a fall or blow experienced by the mother, or from the contraction of the uterus. In the latter case they are often multiple, and the bones of the foetus are diseased (congenital rickets). Fractures also take place in healthy infants from violence in delivery.

Intra-uterine fracture.

Fractures are always divided by English authors into *simple*, which do not communicate with the external air; and *compound*, which are exposed to the air through a wound in the soft parts; and the distinction is an important one, since, as a rule, the two kinds of fractures involve a very different amount of danger, and unite in a very different manner.

Classification—simple and compound fracture.

Fractures are also divided, according to the nature of the separation, into single, multiple, incomplete, and complicated, and these are again subdivided.

Thus single fractures may be *transverse*, *oblique*, or *dentated*. It may be true, as stated by Malgaigne, that the fractures of long bones are never truly transverse, yet the distinction is very important in practice between a fracture

Transverse, oblique, and dentated fracture.

which runs in a tolerably transverse direction and one which is perceptibly oblique, since the latter is so much more liable to displacement than the former. The terms explain themselves, but good examples of each form of fracture will be found in some of the illustrations in



FIG. 28. Incomplete or 'green-stick' fracture of the clavicle, from a preparation (Ser. i. No. 76) in the Museum of St. George's Hospital ('Syst. of Surg.' 3rd ed. vol. i. p. 410).

the sequel. Transverse fracture is best illustrated by the common fracture of the patella (q. v.). A good specimen of oblique fracture is figured in the section on fractures of the lower end of the femur.

To these classes of single fractures separations of the epiphyses should be added—they will be further treated of below.

Multiple fractures are those in which the same bone is broken in two or more different parts of the limb, or in which there are fractures of two or

Splintered and comminuted fractures.

¹ See Jacobson, 'Syst. of Surg.' 3rd ed. vol. i. p. 405.

more different bones; or in which, along with a complete fracture, a splinter has been separated from the rest of the bone ('splintered fracture'), or in which there are several lines of fracture comminuting the bone, i.e. separating one or several large portions from it ('comminuted').

Incomplete and greenstick fractures.

Incomplete fractures are either simple *fissures*, very common in the flat bones, such as the skull, and seen, though rarely, in the bones of the limbs,¹ or *bending* of the bone, which is usually the result of *greenstick-fracture*, i.e. of fracture of a portion of the fibres of the bone, while the remainder are unbroken (fig. 28), such as occurs when a soft bough is bent;² or *perforations*, though these are better described as wounds of bone, or *splintering*, when a small piece only is detached from the bone, its continuity as a whole being uninterrupted. The bone itself may be entirely fractured, but the periosteum may remain untorn, and this seems more common in fractures of the ribs than in any other bone.

Complicated fractures are those in which a joint or some neighbouring cavity is injured (as the pleura in fractured ribs), or when there is lesion of some large vessel, or a wound not exposing the fracture.

Fat-embolism.

A curious complication of fractures, especially compound fractures, has lately been described. I mean *fat-embolism*. The marrow of the bone being crushed by the fracture, it is believed that some of the free fat may pass into the veins and be carried by the blood-stream until it becomes detained in the capillaries of the various tissues and organs. It is principally arrested in the capillaries of the lungs, but other organs and, indeed, almost all parts of the body have been found plugged by these fatty emboli. The symptoms are those of dyspnoea, coming on suddenly and generally within forty-eight hours of the receipt of the injury; irregular action of the heart; cyanosis or pallor, and, in fatal cases, coma, sometimes preceded by convulsions.

¹ These longitudinal fissures in the long bones may, perhaps, be more common than is generally believed. The museum of St. George's Hospital contains a curious specimen of a child's tibia showing a fissure extending longitudinally down the bone, and presenting in quite a different part of the front and back surface. Mr. H. Morris has given an interesting account, partly after M. Féré, of longitudinal and spiral fractures of the femur and tibia ('Syst. of Surg.' 3rd ed. vol. i. pp. 1021, 1043), and I have met with cases in practice suspected to be of this nature, in which the long uselessness and painfulness of the limb after severe injury, unaccompanied by any of the usual signs of complete fracture, gave support to the diagnosis.

² Bending is believed sometimes to occur in the skulls of infants without the rupture of any of the bony fibres.



FIG. 29. A preparation, in St. George's Hospital Museum (Ser. i. No. 137), showing the lower epiphyses of the femur and tibia and both epiphyses of the fibula separated in the same injury.—From Holmes's 'Surg. Diseases of Childhood.'

Separations of the epiphyses (fig. 29) are injuries which it is frequently difficult, sometimes impossible, to distinguish from fracture; in fact, pure separation of the epiphysis occurs very rarely, for in the injuries which are so denominated the fracture usually involves the shaft to some extent, as well as the epiphysial cartilage.¹ In a pure separation of the epiphysis (i.e. where the line of the fracture runs through the cartilage only, and does not trench on the bony tissue either of the shaft or the epiphysis) it is presumable that there would not be the true bony crepitus, though there might be some analogous, but less distinct, sensation. Where the line of junction is broad, as in the upper end of the humerus or lower end of the femur, there will be no shortening, but the lower fragment will most likely project.² If the line of junction be within a joint, swelling of the joint will take place. The nature of the accident will then be marked by the loss of power following injury in a patient of appropriate age, the position of the displacement, the mobility of the epiphysial fragment (which, however, cannot always be ascertained), and possibly by the character of the crepitus, with the symptoms of injury to the joint. The treatment must be the same as for fracture. The chief importance of the subject is that such injuries are sometimes followed by suspended growth of the bone, producing deformity, apparently as the result of degeneration of the epiphysial cartilage after the injury, whereby it loses its powers of ossification. Further remarks on these injuries will be found under the heads of fracture of the various bones.

Separations of epiphyses.

Diagnosis between separation of the epiphyses and ordinary fracture.

The symptoms of fracture are divided into the *rational* and the *sensual*. The former are inferential only, and are given either by the lesion which the fracture produces, such as the injury to neighbouring viscera (of much importance in the chest, head, and pelvis), or by the loss of power caused by the fracture.

Symptoms of fracture.

The *sensual* symptoms are further divided into those which are equivocal and those which are unequivocal. Among the former are to be ranked pain, swelling, and ecchymosis. The pain is fixed and abiding, and in this differs from the pain of contusion, which is more diffused and less persistent. The swelling is due, in the first instance, to extravasation of blood, but, later on, it may be caused by cedema, accompanied by the formation of blebs containing an amber-coloured or blood-stained fluid. These blebs are quite innocuous, but are of importance as a diagnostic sign of a fracture having taken place, in cases where on account of the swelling it might not otherwise be easy to ascertain its existence. In the same way ecchymosis is sometimes almost the only sign of some fractures. For instance, in fracture of the lower end of the fibula, there are often none of the ordinary signs present: no displacement, no crepitus, but the appearance of a linear ecchymosis, at the seat of the fixed pain in the bone, is usually considered to be pathognomonic of the injury. So, again, in fractures of the base of the skull, ecchymosis is the main symptom on which we rely for a diagnosis.

The unequivocal signs of fracture are (a) the crack heard or felt by the patient at the time of the accident, which, for obvious reasons, is not commonly observed; (b) the unnatural mobility of the fragments, which, however, is absent when the fragments are *impacted*, i.e. one fragment driven into the substance of the other,³ and in all fractures of the skull, most of

Crack.

Mobility—impacted fracture.

¹ See Holmes, 'Dis. of Childhood,' 2nd ed. p. 238, note.

² See a figure in the section on fractures of the upper end of the humerus.

³ Characteristic illustrations of impacted fracture are furnished by the extra-capsular fracture of the cervix femoris. See the section on that subject.

Displacement.

Crepitus.

Diagnosis of fracture.

Treatment. General indications.

those of the ribs and pelvis, besides many others; (*c*) the deformity or displacement: which is decisive in all cases where it exists, but it is, of course, very often absent. The displacement of fractures is divided, for purposes of description, into (1) lateral or transverse, when the fragments lie more or less by the side of each other; (2) shortening, or riding, or vertical displacement, when the lower fragment ascends above the lower end of the upper; (3) angular displacement, when one or both deviate from the axis of the limb; (4) rotation, when one or both are twisted on their own axis; and (5) absolute separation. It will be obvious that all the forms of displacement may be variously combined. Displacement is produced by the action of the original violence, aided in some cases by the weight of the body, or by subsequent violence or by muscular action. (*d*) The last and the most important of the sensual symptoms of fracture is the crepitus, or the crackling sensation and sound produced by rubbing the two fragments on each other. This crepitus is the sign commonly looked for, and when found is usually decisive of the nature of the injury; but it is not always present; and in some exceptional cases its presence is not decisive of the existence of fracture. It is a grating sensation which a little practice soon makes familiar and unmistakable to the surgeon; but, as it is produced by rubbing the fractured ends on each other, it cannot be felt when these are immovable, as in all firmly impacted and many dentated fractures, or when the fragments are not in apposition, as when they ride on each other (though in this case and in some cases of impaction they may be brought into apposition or made movable by extension), or are entirely separated, as in many cases of fractured patella; and in some cases where one of two bones of a limb is broken, and the sound bone prevents any movement being impressed on the broken fragments of the other. It seems also that pieces of fascia, muscles, or bloodclot may get between the fragments and prevent crepitus. Taken altogether, however, it may be said that such cases are exceptional, and that in most of them the presence of fracture may be made out by the other signs. Crepitus may be present in cases where there is no fracture. Effusion into the sheaths of tendons or into the cavity of a joint will produce a sensation much resembling crepitus. Effusion round the dislocated head of a bone sometimes leads to a crepitus which very closely simulates that of fracture; and caries of the joint-surfaces is accompanied by a crepitus under passive motion which is identical with that of broken bone. So that cases do occur in which dislocation with considerable swelling, or a contusion or sprain of a diseased joint, is accompanied with crepitus, like that of fracture. But such cases can be distinguished by careful examination, especially with the aid of anæsthesia. It may be occasionally impossible to be quite certain of the absence of fracture in cases of severe contusion and in injuries of the chest, but in such instances it is more prudent to treat the case as a fracture. In injuries of the head also it is impossible to affirm the absence of a simple fracture without displacement. But the point is one of little moment. Thus it may be confidently stated that fractures constituting substantial injuries are usually easy to diagnose.

The general indications of treatment are very simple, but the method of carrying them out in practice can only be understood by studying each fracture separately. These general indications are: (1) to reduce or 'set' the fracture, i.e. to place both fragments in the position which they occupied before the accident; (2) to maintain the fractured ends in position for a period which experience shows to be sufficient to avoid further displacement,

and which varies for different fractures and at different ages ; (3) to counter-act unfavourable symptoms and complications.

1. A patient known or suspected to have received a fracture ought to be conveyed home with all possible care, having the limb defended by some temporary contrivance from all risk of further movement, whereby many simple fractures are made compound. For this purpose pieces of thin board or of sticks or of pasteboard may be used, with such impromptu bandages as can easily be made out of the clothes. He should be placed in bed (in cases at any rate of fracture of the lower limbs) before any serious examination is made, and the clothes carefully cut off the injured limb. Then, in order to reduce the displacement, its nature should first be carefully ascertained, and steady gradual *extension* made in the appropriate direction by the surgeon, or, if necessary, by an assistant. Another assistant makes *counter-extension*, i.e. steadies and fixes the other part of the limb and body so that the extending force acts on the lower fragment only. When by these means the proper length is restored a little judicious manipulation will remedy any angular, lateral, or rotatory displacement. In impacted fracture more powerful extension may be required in order to disengage the fragments and restore the length of the limb, for which purpose an anæsthetic is to be given. But the violence necessary to disengage an impacted fracture often produces disastrous consequences, and in most cases the patient will be well advised to submit to the deformity which must ensue rather than run the risks incidental to violent extension.

Setting the fracture.

In setting a compound fracture there is often great difficulty from the protruding fragment being tightly girt by the skin and other parts, or from the irregular projection and interlocking of comminuted fragments. It must be remembered that there are two ways in which a fracture may be made compound, which are best illustrated by fractures of the leg. In one case a cart-wheel may have passed over the limb, crushing and tearing the soft parts off the bone at the same time that the latter is fractured. In this case there will most likely be a large wound, giving free access to the fragments which are not likely to be embraced by the wound, though comminuted portions may require removal or replacement before they can be accurately adjusted. In another case a man receives a simple fracture, and in his efforts to raise himself or in other muscular efforts he drives one fragment (generally the upper) through the skin. The fragment often protrudes to a great distance, and is tightly grasped by the skin ; but the wound is much smaller and less contused, and the chance of its rapid union much greater. Whenever there is any difficulty in the reduction of a compound fracture an anæsthetic should be administered, and the cause of the difficulty carefully ascertained. If it be the small size of the wound probably a free division of the skin will enable the surgeon to reduce the fragment, otherwise the latter must be sawn or clipped away. If comminuted portions interpose they may be occasionally pushed aside ; but as they are generally much loosened from the soft parts it is better to take them away. If portions of muscles or fasciæ are wedged in between the bones they can be drawn aside with a blunt hook or director. When the fracture is fairly set, it must be put up so as to leave the wound exposed, in order that the dressings may be applied without disturbing the fracture ; and it is often advisable to make a counter-opening, and pass a drainage-tube through the wound and this counter-opening, in order to keep the seat of the fracture free from blood and other decomposable

matters. This end is effectually secured by periodical syringing through the drainage-tube.

Amputation.

Amputation is required in cases where the main arteries, nerves, or joints are also injured, or where the laceration of the soft parts is so great that gangrene is inevitable. But the indications for amputation differ much in the lower and upper limb. Thus, in compound fractures laying open the knee-joint, amputation is usually (though by no means always) necessary in the adult; while, in compound fractures of the elbow and shoulder, amputation is only performed in exceptional cases; and similarly with injuries to the vessels or nerves, the surgeon is much more disposed to recommend amputation in the lower than in the upper limb; and in all cases injuries which in the adult are a decided motive for amputation may be brought to a perfectly successful issue in a healthy child without any operative interference.

Apparatus to maintain reduction—splints.

2. When the fracture has been reduced the next care of the surgeon is to maintain reduction. The general nature of the apparatus used for this purpose need alone be treated of in this place, since the special contrivances applicable to each form of fracture will be described with each.

Fractures communicating with the cavities of the head and trunk, as a rule, require no special apparatus. In fractured ribs, and sometimes in fractured pelvis, a bandage is applied to maintain the parts at rest; but even this is often found unnecessary.

In the extremities, however, some firmer basis is usually required, in order to maintain the extension, and to prevent accidental displacement. This is provided by *splints*, i.e. pieces of wood or metal, or of some malleable compound such as pasteboard, adapted to the size and shape of the limb, embracing it more or less completely, and fixed on by bandages, webbing-straps, or otherwise, so as to keep the fractured ends as accurately as possible in position, and immovable, during the whole time of treatment. Many of these apparatus will be found figured or described in the sequel, under the head of the Special Fractures; and I do not know that it is worth while to give any general description beyond what is to be found in the chapter on MINOR SURGERY as to the art of splint-making. Its main principles, however, can hardly be too often recapitulated. They are these: the splints should fit the limb as evenly as possible, extending as far on either side of the fractured part as is necessary to keep the fracture quiet, without limiting the movement of the neighbouring joints, unless, indeed, it is necessary, with a view of obviating displacement of the fractured bones, to include the joint in immediate contiguity to the fracture, and this is very often the case.¹ The splints should not be so applied as to impede the return of blood from the limb and produce œdema, still less so as to oppose the supply of blood, by which gangrene and the loss of the limb has sometimes been caused. The splints must not press anywhere on the soft parts so sharply as to cause ulceration.

Some surgeons prefer to put up the fracture at once in some form of immovable apparatus, such as plaster of Paris, mill-board, &c. The advantages derived from this method are that it enables the patient to get up and go about his occupation (on crutches, if the fracture is in the lower extre-

¹ Boyer, many years ago, laid down the rule that the splint should always be sufficiently long to embrace the joint above and below the fracture. The rule is undoubtedly a good one, but not capable of universal application, as, for instance, in fractures of the humerus, where the necessary flexion of the elbow prevents the anterior splint from projecting beyond the joint.

mity) during the whole time the broken bone is uniting, whilst the objection to it is that it prevents our ascertaining what is going on at the seat of fracture, as it is completely concealed from view. To obviate this, certain forms of movable 'immovable' splints have been devised, which should always be used when the surgeon determines to put up a fracture in a fixed apparatus from the first. Of these, the ones in most common use are the Bavarian splint (described at a future page) and Croft's plaster of Paris side splints.¹

Another form of retentive apparatus is the *junk*. It is used only in fractures of the lower extremity. Its name is derived from *juncus*, a reed; because it was originally made of reeds quilted between two pieces of stout calico. It now usually consists of a thin cushion, stuffed with horse-hair, of sufficient size to encircle the limb. This is strengthened on its outside by a piece of stick sewn into the two opposite sides of a square of calico rather bigger than the pillow. The leg is wrapped in the cushion, after the fracture has been set, and is steadied by being encircled with the calico containing the sticks, which prevent any lateral or vertical displacement. The angular displacement which might result from the toes dropping, and thus projecting the upper end of the lower fragment forwards, is obviated by bandaging the foot at right angles. Junks.

Hyponarthetic apparatus, or fracture-boxes, as they are more familiarly termed, are troughs in which the limb is fixed by various contrivances of straps, bandages, &c., screwed to the framework, so that the limb is maintained in the precise position in which it has been placed after extension. The trough is often formed of two pieces jointed together, so as to keep up the extension by means of a rack and pinion. Hyponarthetic apparatus.

The usual means of maintaining a permanent extending force by which the lower fragment may be drawn away from the upper, is by means of a weight and pulley passing over the end of the bed, as is commonly done now in disease of the hip, and which will be found delineated in the section on that subject. This plan is much in use in America, I believe, in fracture of the femur; but in England it is used chiefly as an adjunct to the splints. Extension apparatus.

One of the most painful and distressing features in the ordinary treatment of fracture of the lower extremity, when the limb is kept immovable on the bed, is that this immobility prevents the patient from making any but the most restricted movements of the rest of the body. Hence the invention of the *swing*, of which the kind now in almost universal use for the lower extremity is that devised by Mr. Salter, which will be found described in the section on Fracture of the Leg. Injuries of the arm and excisions of the elbow are often treated, with great comfort to the patient, by swinging the arm by means of a pulley from a pole projecting over the bed or from the bedstead (see Excision of the Elbow). Swings.

3. After the fracture has been set and put up, the only thing necessary is to keep watch for, and counteract, any complication which may ensue. In cases of simple fracture these are commonly few and trivial, so that these fractures are hardly ever dangerous to life, and with moderate care are usually brought to unite without serious deformity. The chief points are: to see that the displacement is not reproduced, through slipping or imperfection of the apparatus, and to that end to renew the measurement, and, Treatment of complications.

¹ 'Med.-Chir. Trans.' vol. xliv. p. 295.

if possible, examine the seat of fracture from time to time—say every week; to combat the painful spasms which sometimes attack fractures, for which purpose equable pressure, as by careful bandaging or strapping, is the most efficient treatment; to relieve the neuralgic pain, which is occasionally very distressing, by blisters dusted with opium, or morphia, by hypodermic injections, and by the usual remedies for neuralgia; to treat the very distressing itching which sometimes attacks the skin by sedative ointments or lotions; and to open abscesses, should any unfortunately form, as early as necessary.

Compound fractures are much more difficult to treat with success, and far more exposed to complications of all kinds. They usually unite by suppuration and granulation, especially in the lower extremity; the inflamed bone often dies; the matter frequently burrows about the limb, requiring incisions in various parts, which interfere with the application of the splints. The surgeon, therefore, has to be constantly on the watch to provide free exit for retained matter, to remove sequestra, to incise tense, inflamed parts, and to combat all other complications.

Wounds of
bone and
injuries of
cartilage.

Wounds of bone are not exactly the same thing as fractures, yet it is difficult to establish any essential difference. As seen in practice they are generally caused by gunshot, which sometimes perforates the bone, punching a hole more or less cleanly through it, or else splinters, and comminutes its substance, causing a compound fracture. In rarer cases the bones are cut into by a sharp-edged weapon, without any solution of continuity of the entire bone, though very probably fissures may run down, radiating from the wound to some distance in its substance. These wounds of bone are liable to many of the same dangers as compound fractures, and they unite by the same process.

Closely connected also with the subject of fractures of the bones is that of injury of cartilages. In many cases of fracture—in all those which communicate with joints, and in many of those of the ribs—the cartilages are also fractured; and many wounds involve the cartilages to a greater or less extent. Some of these injuries are definite subjects of surgical treatment—as, for instance, fracture of the costal cartilages—which will be found treated of in the sequel: but as a general rule the injury is an unnoticed and a subordinate complication of a graver lesion. The process of union will be spoken of hereafter.

UNION OF FRACTURES.

The union of simple fractures is generally effected by a process of inflammatory exudation and organisation analogous to that of union by first intention in soft parts; while compound fractures usually unite by a process of suppuration and granulation (second intention); but exceptions occur to both these rules, i.e. we meet sometimes with simple fractures which heal by suppuration, and with compound fractures which unite by simple adhesion.

Union of
simple
fracture.

The process of union of a simple fracture may be thus described:—

The injury causes effusion of blood around the fractured ends, and between the bone and periosteum, as far as the latter is torn away from the bone. The muscles also are more or less lacerated. All this is repaired in the usual way; the blood being gradually absorbed,¹ and the muscular fibres united

¹ The reader may be referred to a paper by Mr. J. Greig Smith, on the 'Histology of Fracture-repair in Man,' 'Journ. of Anat. and Phys.' Jan. 1882, and to Mr. Jacobson's

by fibrous tissue. This process is going on simultaneously with that of the repair of the fracture itself.

Supposing the fracture to be placed in good apposition and kept quiet, a fibrinous material is exuded between the fractured ends. The period at which this exudation commences varies with many circumstances—the patient's age, the size of the bone, &c. For a large bone in an adult it may be given at about ten or twelve days. The exudation (technically termed 'callus') is furnished by the vessels both of the bone and of the periosteum.

Fibrous tissue and earthy material are developed in this exudation almost simultaneously in many cases; and sometimes, especially in children, fibro-cartilage. True cartilage is met with in animals, but its occurrence in man is doubtful. The 'callus,' or uniting material, is then developed into bone, as in the intramembranous process of ossification. The new bone is spongy and porous at first, but gradually hardens.

If the fragments are not in good position this tissue may fill up the angle between them, or even extend into the medullary tube. It fills all the space internal to the periosteum (i.e. the whole medullary canal); and if the periosteum has been torn, that membrane is at first lost in a mass of newly-formed callus. Gradually this mass is modelled down, the medullary tube is restored, and the periosteum again becomes recognisable.



FIG. 30. A badly-set fracture of the femur. The two fragments are united by a bridge of soft bone, which at the time of the patient's death (ten weeks after the accident) was so porous as to give way in part during maceration. The ends of the medullary canal are sealed. The upper fragment is lying on the inner side of the lower; the lower fragment is directed from below outwards and backwards.—From St. George's Hospital Museum, Ser. i. No. 167.



FIG. 31. Union of fracture by the attachment to each fragment of a bridge formed by a separated splinter.—From a preparation (No. 2,938) in the museum of the Royal College of Surgeons. ('Syst. of Surg.' 3rd ed. vol. i. p. 435.)

essay on Fractures, 'Syst. of Surg.' 3rd ed. vol. i. p. 436, for a very interesting account of the changes in the blood-clot around fractured bones. If these researches are confirmed they would prove that the clot does in some cases (though probably not usually) ossify, and thus takes an important part in the union of fracture.

When the fragments overlap, the uniting medium is developed only between them—not, as a rule, over the exposed ends or in the medullary canal; but as to the latter point there is considerable variety in different cases. Fig. 30 shows a simple fracture, where the patient died before the union was quite firm. The callus which was thrown out has become ossified, though the ossification is not yet complete. The bony deposit, however, is seen to extend over the end of the medullary canal of the upper fragment; and this is the case in the lower fragment also. If the reader will compare some of the illustrations to the chapter on INJURIES OF THE LOWER EXTREMITY he will find that the condition of the medullary canal varies considerably. It is difficult to draw any precise limit between the process now described and that union by ensheathing callus which will be described presently. In this simple form of union, however, the uniting material usually fills up only the angle between the fragments and the space which is left between the detached periosteum and the bone, and this space is not often great. But there are cases where such periosteal deposits, uniting with separated splinters, form substantial bridges across the fracture, and afford a great deal of the solid uniting material (fig. 31).

The microscopic appearances of the parts concerned in the fracture are those of inflammatory changes in the periosteum, endosteum, and bone. The periosteum becomes quickly much swollen and softened for some two or three inches on each fragment (the amount and extent of this varying with the severity of the injury and the amount of disturbance afterwards), and the thickened portions of periosteum blend and unite into a single mass at the seat of fracture. This mass has essentially the same structure as the inflamed deep layer of the periosteum with which it is continuous, and it is developed into bone exactly as in the ossifying (or chronic) form of periostitis, the membrane becoming swollen and studded with cells (leucocytes) which are sometimes encapsuled in hyaline material, so as exactly to resemble cartilage, and in this softened mass bony spiculæ are formed just as in normal processes of ossification. The soft spongy bone so produced gradually hardens and becomes modelled down, so as in the best cases to leave hardly a trace in after-life; and the closer the apposition of the fragments and the more careful the treatment, the smaller is the amount of the uniting medium, and the nearer does the process approach to that of the natural growth of bone. So for the fractured ends. At first they soften and become spongy in the rarefying stage of ostitis; 'the lime salts disappear, and the cellular medullary tissue set free forms a spongy mass of callus that closes the end of the shaft, and meets with the corresponding mass in the other fragment. These masses unite with each other, so that the continuity can be at once restored by the ossification of this *internal callus*. Afterwards, when this callus has become thoroughly developed into ivory bone, a modelling process of atrophy

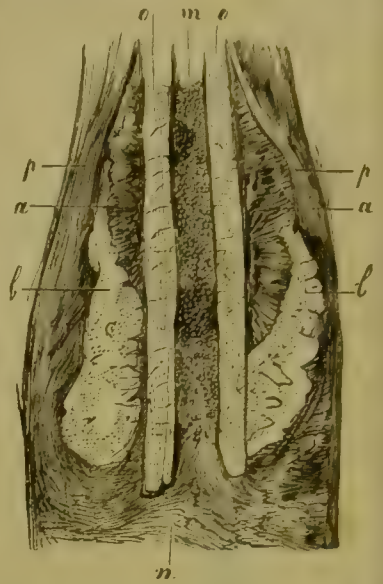


FIG. 32. The upper fragment from a fracture in an animal. The lower fragment is not shown, but exhibited similar characters. *o*, the old bone; *m*, its medulla; *a*, new bone, containing a large quantity of embryonic medulla, which renders it opaque. The general direction of the vessels in this new bone is perpendicular to the surface of the old bone; *b*, cartilage; *n*, embryonic tissue interposed between the two fragments and penetrating into the medullary cavity; *p*, circumjacent tissues blending with the periosteum.—From Cornil and Ranvier.

re-absorbs that portion which filled up the marrow-canal.'¹ The same observations apply to this internal as to the external callus, viz. that its amount and the proofs of its inflammatory nature vary with the severity of the lesion and the amount of disturbance.

In animals, and in man when the fractured ends are not kept quiet, this process is modified by the formation round the fractured ends of a ring or splint of 'provisional' or 'ensheathing' callus.

Union by
provisional
callus.

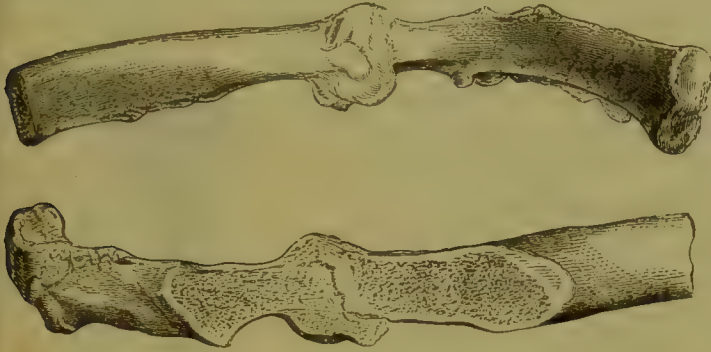


FIG. 33. Union by provisional callus in the human subject. The provisional callus has ossified, the fractured ends being still united by fibrous tissue only. A fractured rib three months after the accident.—St. George's Hospital Museum, Ser. i. No. 72. ('Syst. of Surg.' 3rd ed. vol. i. p. 432.)

The process of formation of provisional callus has been artificially divided into five stages:—

1. The first is that of exudation of reparative material, external and internal to the fragments, i.e. between the fragments and the

periosteum, and between the medullary membrane and the bone. This occupies a period averaging from eight to ten days.

2. The provisional callus then acquires the firmness and structure of fibro-cartilage or cartilage in from ten to twenty-five days.

3. Both the external and internal callus then ossify into spongy bone in from twenty-five to sixty days.

4. The provisional bony callus is then modelled down and becomes compact bone, the ends of the fracture being still distinct from each other (fig. 33).

5. Lastly, the permanent bond of bony union, or 'permanent callus,' forms between the broken ends, and the provisional callus is more or less completely re-absorbed; so that the periosteal swelling disappears, and the medullary canal is restored. The period occupied by these two latter stages of the process is too uncertain to be stated even approximately.

In some cases the provisional bony callus remains permanent, and the fractured ends lie within it, either ununited or only connected by ligament.

As the formation of provisional callus is the result of the irritation produced by motion of the fragments, it is exceptional in man, though by no means unknown; while, on the other hand, its absence is rare, though also not unknown, in animals. In the human subject the ribs, which cannot be kept immovable, usually unite in this manner, and the clavicle for the same reason very generally. Any fracture, however, which from accidental circumstances cannot be treated in the usual manner may undergo this process, of which the humerus represented in the annexed figure (fig. 34) is a good example. For obvious reasons it is more common in childhood. The buttresses of bone which are sometimes found around fractures, particularly near the hip, are analogous to the provisional callus, and are formed by a process of ossification going on in the fibrous tissue and tendons around the fracture, which has been denominated *parostosis*, and which the reader will find minutely described and figured by Mr. Jacobson in the 'System of Surgery,' 3rd ed. vol. i. p. 437.

¹ Wilks and Moxon, 'Path. Anat.' pp. 33, 34.

Union by
granulation.

The union of inflamed simple fractures and of compound fractures is by granulation. Suppuration is set up at the site of injury, and granulations are formed in the thickened and inflamed soft parts, and on the ends of the fractured bone. The granulations are converted into fibrous tissue and gradually fill up the cavity of the wound. Subsequently that portion of fibrous tissue which lies between the broken ends and unites them together becomes converted into bone, and so the union is completed. This union by granulation is a far more tedious process than that by adhesion, generally occupying as many months as the other does weeks; and it is liable to all kinds of irregularities from the separation of fragments which become necrosed in consequence of the suppuration of the parts which surround and nourish them, from erysipelas or diffuse inflammation, from burrowing of matter in the limb—in fact, from all the complications incidental to severe injuries involving bone. And such suppurating compound fractures are one of the most fruitful sources of pyæmia. It is therefore important to procure the immediate union of the wound—whenever that is possible—so as to convert the compound into a simple fracture; and this is the more important the more vital is the organ which is in contact with the fractured bone. This, however, can only generally be done, if the wound is a mere puncture caused by the protrusion of the sharp end of one of the fragments. If the wound is larger, or if the edges are lacerated and contused, it will be useless to attempt to close it, and it must then be treated in the strictest antiseptic manner possible. The wound must be thoroughly syringed out with a strong solution of carbolic acid (1 in 20) or other antiseptic, care being taken that the lotion is made to permeate all the recesses of the wound; efficient drainage must be provided for, and the wound dressed by one of the antiseptic methods mentioned on a previous page.

Irregular
union.

Irregularities occur in all these processes, whereby special cases are made to differ from that which is regarded as the typical course of each kind of union. The chief of these irregularities which needs notice here is the absorption which sometimes goes on in the neighbouring bone contemporaneously with the union of the line of fracture itself. This is often seen in thin papery bones like those of the orbit (see INJURIES OF THE HEAD). And it is often noticed that fractures of the base of the skull, though they may unite, do so very imperfectly, and that fissures of the vault are often wider when the repair is complete than they were at the time of the injury.

The arrest of the process of union at any stage will lead to the various forms of ununited fracture, as will be obvious from the sequel.



FIG. 34. Union of fracture by ensheathing or provisional callus in the human subject. The patient was admitted into hospital with fracture of the humerus, which could never be kept quiet, in consequence of his suffering from repeated attacks of delirium tremens, of which he died about a month after the accident.

A. A dentated fracture was found just below the insertion of the deltoid muscle, and the fractured ends were encased in a sheath or ferule of fibrous tissue about a quarter of an inch thick, and extending about an inch above and below the fracture. The fragments are entirely ununited to each other, and are free from any periosteal deposit of callus. They are freely movable on each other to the extent permitted by the attachment of the provisional callus.—St. George's Hospital Museum, Ser. I. No. 105.

The usual period for the union of each fracture is specified in treating of each. But it must be understood that these periods are averages only. Delayed union.



FIG. 35. Ununited fracture (soft union) of the ulna.—St. George's Hospital Museum, Ser. i. No. 202a.

Various disturbances of health may cause delay in union—such as acute diseases, as fever, or chronic affections, as scurvy, possibly syphilis, and frequently mal-assimilation of food leading to a phosphatic state of the urine.¹ All such causes, however, allowing the reality of all of them (which is a matter of considerable doubt), are rare; far more commonly the union of fracture is delayed or prevented by injudicious treatment, as by tight bandaging, obstructing the blood-supply, or the other extreme of negligent apposition, allowing movement. But cases of delayed union are met with in which no such cause can be traced, where the patient seems to be in his usual health, and the fracture to have been properly treated.²

In such instances of delayed union the indications for treatment are obviously, in the first place, to examine the patient's local and general condition, with a view to correct alkalescence of urine by careful dieting, and the exhibition of mineral acids, to neutralise the syphilitic

condition by mercury or iodide of potassium, and to improve the general health by fresh air if possible. The local condition must be improved by correcting any obvious defect in the apparatus employed, and by gently rubbing or shampooing the parts around the fracture. Some fractures of the lower limb, which have remained movable beyond the usual time, will unite if the patient is allowed to get up and move about a little with the limb in a splint firm enough to prevent it from bending, yet not so tight as to make it swell. In other cases (whether in the upper or lower limb) union may be procured by fixing the two fragments in an apparatus made of two parts movable on each other, and provided with a screw and ratchet, by which the fragments can be pressed together. The aim of all these devices is to excite a little more action in the parts, and thus stimulate the fractured ends to throw out bone.

By some such means as these union may be procured, even after considerable delay, when there is no definite obstacle to it. There will still remain a small proportion of cases in which the fragments continue permanently ununited—at least by bone—and therefore are freely movable on each other.

Ununited fracture.

This takes place in one of three ways, i.e. the fragments are either united by a soft material (which is sometimes called ligamentous union) or by a false joint; or they are truly ununited, i.e. are in no apposition whatever.

The first form of ununited fracture is seen in fig. 35, and a comparison of fig. 34 will show its striking similarity to the condition of a provisional

Ligamentous union.

¹ Pregnancy and lactation are said sometimes to retard union, though they certainly do not commonly do so. The subject is discussed, and several interesting cases quoted, in Norris, 'Contributions to Practical Surgery,' pp. 25, 28. The cutting off of the blood-supply through the nutrient artery is also believed by Mr. Curling to retard union ('Med.-Chir. Trans.' vol. xx.). And Mr. Callender has pointed out the frequency of obstruction of the main vein, from contusion in the injury, causing oedema, as a condition involving delay in the union of the fracture ('Med.-Chir. Trans.' vol. li. p. 152).

² On the far greater frequency of the local causes of non-union, especially bad treatment, than the constitutional, see Callender, *op. cit.* Simple fractures appear to remain ununited far more commonly than similar compound fractures do.

callus before ossification. Sometimes, indeed, in these cases of soft union there is a regular provisional callus enclosing the broken ends in a splint or ferule, just as is seen in animals, and possibly containing fibro-cartilage. This soft or ligamentous union is the most common condition of ununited fracture.

False joint.

Another form of the lesion is that which is shown in fig. 36, in which by the movement of the two parts of the fracture on each other a *false joint* ('*pseudarthrosis*') has been formed in the centre of the soft uniting medium, which then takes the form of a more or less regular capsule.¹

True non-union.

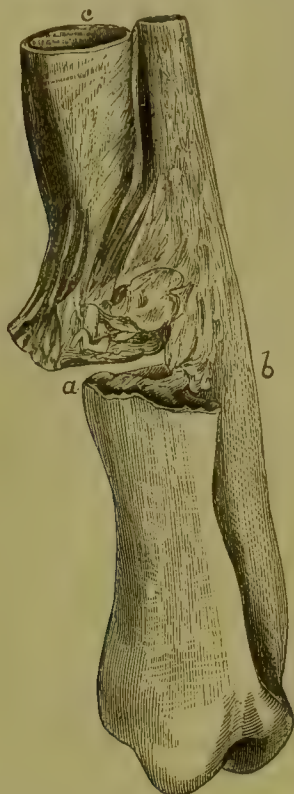


FIG. 36. An ununited fracture (false joint) of the tibia. The fracture had existed seventeen years, and the utility of the limb had been almost perfect, the patient having gained his livelihood by walking as a messenger at one of the clubs; he merely used a stick. The ends of the fracture, *a*, are rounded, the lower end being worn into a kind of cup to receive the upper end. They are lined by a fibro-cartilaginous substance, and were enclosed in a firm fibrous capsule, which has been removed in order to display the false joint. There was even a membrane lining the ends and secreting a substance something like synovia. A false joint also exists between the tibia and fibula, near the fracture. The fibula, *b*, is much curved and is very much thickened, so as to bear the weight of the body. The tibia, as shown at *c*, is considerably atrophied, so that a thin shell only remains to represent its compact exterior.—From a specimen in St. George's Hospital Museum, Ser. i. No. 202.

Again, the broken ends may be in no apposition at all. A familiar example is that of a fracture of the patella, where the fragment is sometimes displaced far up the thigh, and is quite unconnected with the part which remains attached to the tibia. Fig. 37 shows another example of something of this kind. In that preparation, however, though the upper ends of the lower fragments are in no connection whatever with the lower ends

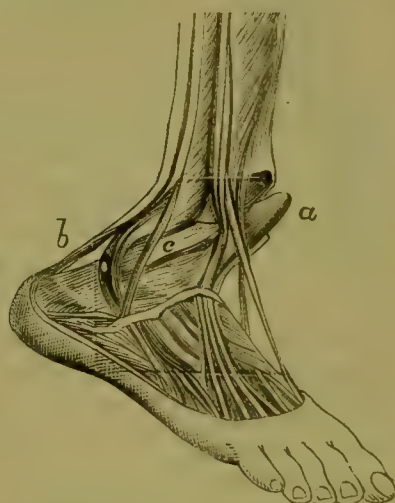


FIG. 37. Ununited fracture of both bones of the leg in a child æt. 10, for which amputation was performed. The leg had been fractured eight years before, and had, it was said, been refractured on two subsequent occasions. *a*. The atrophied upper end of the lower fragment of the tibia, above which is seen the lower end of the upper fragment. This is not in any contact with the former, but is united to the back of the lower fragment below by a kind of capsular membrane. This is the case also with the fibula. The upper end of the lower fragment of the fibula is not plainly seen, being buried in the fibres of the extensor long. dig. *c*. shows the lower fragment of the fibula. The tendons of the tib. anticus and extr. prop. pollicis are seen pushed outwards by the fragment of the tibia. *b*. shows the heel and the atrophied Tendo Achillis.—From St. George's Hospital Museum, Ser. i. No. 203.

of the upper fragments, yet these latter have an imperfect fibrous connection to a lower part of each lower fragment, so that it may be said that some attempt, though very imperfect and ineffectual, has been made to re-establish the solidity of the limb.

¹ There is an interesting preparation in the Museum of the College of Surgeons showing numerous loose bodies ('loose cartilages') in one of these false joints. See 'Syst. of Surg.' 3rd ed. vol. i. p. 441.

It is not easy during life to give a confident opinion as to the exact anatomical condition of a case of ununited fracture; but if the fractured ends are widely separated, and no motion of one is produced by moving the other, we may suspect entire non-union; if they move freely on each other with grating, or pseudo-crepitus, like that felt in an old rheumatic joint, we conclude that the case is probably one of false joint; if they are more or less freely movable on each other, but without grating, we may put it down as probably an instance of ligamentous union, remembering also that this is by far the most common condition, as it is also the most favourable for treatment.

In cases of true non-union, and frequently in those of false joint, the fragments are greatly atrophied, as shown in the figures; in some rarer cases of false joint they may be enlarged.

The treatment of ununited fracture must be regulated in the first place Treatment.
by the utility of the limb, and in the next place by the age and health of the patient. The former varies very greatly. Thus fig. 36 shows a case in which the fibula having remained unbroken (or having united), and having also become sufficiently hypertrophied to bear the weight of the body, the leg was so useful that the patient could earn his living by walking. In such a case it is needless to say that there is no motive for surgical interference. Sir Prescott Hewett told me of a case which he had seen in private, where a lady had an ununited fracture of the femur. This was most freely movable when she lay down, but when she stood up the two fragments locked together in such a way that she could walk fairly well, though with a limp. In such a case, and in fact generally, when the patient's life is not made wretched by his infirmity, it is better to avoid any serious operation, for all such operations involve a good deal of danger. All operations on the upper limb are both more likely to succeed and much less dangerous than similar operations on the lower extremity. As there is no absolute separation between cases of delayed union and those of non-union, it is better to treat every case when first seen, if at any reasonable period after the injury, by the milder measures which have been recommended in cases of delayed union. I have seen judicious apposition and mutual pressure of the fragments on each other by means of a rack-and-pinion apparatus successfully employed in such cases. Shampooing the part, slight rubbing of the fragments on each other, occasional slight inflammation set up by blisters and other means, have been recommended. Mr. Thomas speaks of having cured ununited fractures by striking the parts with a mallet.¹ And of course careful attention to the general health, and especially the condition of the urine, is understood to be a necessary preliminary to all kinds of treatment.

If these means fail, and if the loss of power is not grave enough in the surgeon's judgment to justify his exposing the patient to any risk of his life, or if the patient is in such a condition of health that he can hardly be expected to survive the operation, the case must be abandoned, with such palliation as an apparatus can provide.

In cases, however, which are more hopeful as far as the patient is concerned, and where the infirmity is grave enough to justify the risk, the surgeon must very carefully examine the relations of the fragments to each other; their connection, as far as he can make it out, their size, and the possibility of bringing their ends into apposition by extension. He then has the choice of a great number of expedients. There are cases of false joint in which the cavity

¹ Liverpool and Manchester Reports, 1876, p. 27.

Subcutaneous
scraping
of the ends.

Seton.

Ivory pegs.

Drilling.

Metal
sutures.

Resection
of ends.

Sub-periosteal
resection.

Transplan-
tation of
bone.

between the fragments may be obliterated by scraping the ends with a tenotomy-knife, keeping them afterwards at rest in the natural position ; and other cases where union seems to be prevented by some piece of muscle or fascia which has got between the fragments, and where a similar operation will succeed. There are cases (apparently both of false joint and of ligamentous union) where ossification has ensued on the passage of a seton between the ends, which should not be allowed to remain in much above a week. The measure appears to have had little success in England. Dr. Norris, however, says of it that ' results in America have proved it one of the safest, least painful, and most efficacious of the numerous operations that are performed for the cure of pseudarthrosis ' (op. cit. p. 90). Sometimes the surgeon has cut down on the fractured ends in order to pass the seton ; but, as a general rule, when a seton cannot be passed without a previous exposure of the bone, the probably more effectual and certainly less dangerous expedient is adopted of driving ivory pegs into the fragments, as recommended by Dieffenbach. The fragments are sufficiently exposed to drill holes into them, and then into these holes ivory pegs are driven, and the projecting ends cut off. The buried part excites an effusion of bone around, and by such effusion the fracture is united much as it is by the periosteal bridge of bone figured on p. 129. The buried part of the peg sometimes makes its way out, sometimes perhaps it is absorbed, and probably is sometimes encapsuled, and remains as lodged bullets do. The number of pegs to be driven into each fragment will depend on the size of the bone, and other circumstances. Mr. Erichsen speaks of having successfully used five pegs in a fracture of the humerus. Mr. Bickersteth has used copper nails in the same way,¹ or has driven a drill, the end of which is removable, from one fragment into but not through the other, and left the drill in the bone until it fell out. If one drill be not enough to support the fragments, two or even more can be employed, a plan which has the advantage of requiring no external incision. The drills are simply driven in from the surface of the body.

Another plan is to drive a metal suture from one end into the other by means of the drill, which is made to perforate both fragments obliquely ;² but this is commonly combined with the next plan, viz. :

To cut down on the fracture and to remove a slice from either fragment, after which the ends may be wired together, if the surgeon thinks right. Mr. Mason suggests that a needle may be driven through the ends, and the wire cast in a loop or figure-of-8 round the needle, and this may be necessary when the surfaces are very oblique, otherwise the simple insertion of a peg or pin is sufficient to keep the fragments in apposition.

The late Mr. Jordan of Manchester suggested the sub-periosteal resection of the fragments,³ a tube of periosteum being dissected up first, and the portions of bone removed, as far as possible bare of periosteum ; and though this may not always be practicable, yet there is no doubt of the desirability of saving any periosteum which can be recognised and separated from the bone.

Lately an operation has been described by Professor Nussbaum of Munich in a case of non-union of the ulna, the result of loss of bone from gunshot fracture, which he denominates ' transplantation of bone.'⁴ It consists

¹ ' Med.-Chir. Trans.' vol. xlvii. p. 115. See also Mr. Hill's paper in *Liverpool and Manchester Reports*, 1876, p. 64.

² Mason, ' Med.-Chir. Trans.' vol. liv. p. 313. Thomas on ' Fractures of the Lower Jaw.'

³ ' Traitement des Pseudarthroses par l'Autoplastie périostique,' Paris, 1860.

⁴ ' Lond. Med. Record,' March 31, 1875.

essentially in cutting off from the rest of the bone a portion of its external shell covered by the periosteum, and leaving this shell of bone attached to the remainder by means of the periosteum covering its terminal extremity, which is to be carefully preserved from injury, since it is the medium of the future repair. The semi-detached and now quite movable bone is next displaced into the gap in the same way as a flap of skin is twisted in a plastic operation, and fixed in the indurated soft tissues of which the gap is formed. The uniting ligament and the atrophied ends of the fracture, together with the cartilaginous [fibrous ?] tissue which covered them, are removed, as being in the way. This operation could only be attempted in cases where the separation between the fragments is unusually great : and its utility must be tested by further experience.

After all operations for ununited fracture it will be recollected that careful support in a firm splint or case of leather, plaster of Paris, or other material is indispensable.

There are many cases where subcutaneous section of the muscles which displace the fragments must be added to the other operative proceedings.

Finally, there are cases so complicated, or of such long standing, or where previous operations have so far failed, that amputation may be best.

Amputation.

The fracture may have united by bone, but with considerable deformity and loss of the functions of the limb. The various kinds of *vicious union* spoken of are union of two contiguous bones, union with displacement, and projection of one of the fragments. The first and last may be summarily dismissed. Union of two contiguous bones is of no importance in the ribs, and of comparatively little in the leg. In the forearm it has, in one recorded case, been held to justify the resection of the bone.¹ Projection of one of the fragments, or possibly of a comminuted piece, is to be dealt with like any other exostosis, i.e. when sufficiently inconvenient the projecting piece must be removed. But the cases we are ordinarily called upon to treat are those in which, from neglect, from unruliness on the part of the patient, or from yielding of the union after supposed cure, the deformity has either never been corrected, or has recurred, and the limb is more or less entirely useless. Such cases are by no means hopeless. If only a short time has elapsed after the injury the deformity will often yield to extension by the pulleys, combined with firm pressure on the part, under chloroform ; or it may be reduced more gradually (as bent bones are in childhood) by pressure, with pads, &c., on the angle ; the pressure being antagonised by a splint on the opposite side of the limb. In many cases re-fracture of the limb is justifiable, and in almost all in which it is indicated the attempt may be made with impunity. The danger of producing fresh fracture at the wrong place is so slight that it need hardly be taken into account. Mr. Skey² has shown that even the smaller bones, such as the radius or the fibula, are not easily broken, even when out of the body, by the utmost force which a strong man can exert ; and, when covered by soft parts, they would be still less easy to break ; while the larger bones, on which the attempt is usually made, the femur or tibia, are of course quite secure. But at the seat of fracture, and especially in cases of vicious union, the uniting material remains long imperfectly ossified, and will give way in some cases more than a year after the injury. I have seen the femur re-fractured, thirteen months after the accident, with perfect ease. The operation is a very simple one. The limb is brought

Vicious union.

Re-fracture of bone.

¹ By Gardeil, quoted by Malgaigne, p. 272, Packard's translation.

² 'Med.-Chir. Trans.' vol. xlii. A most valuable paper on this subject.

over the edge of the table a little beyond the fracture; its upper part is steadied by assistants, and the surgeon leans on it with all the force he can exert till it gives way, changes of position, rotation, &c., being employed as may be necessary. Mr. Skey says, 'the act of disuniting the bone is effected by slow laceration rather than by a snap or fracture;' in fact, its possibility depends on the ossification of the callus being incomplete. After it has been effected the limb must be extended as nearly as possible to the original length, by pulleys if necessary, and fixed by splints in that position.

There may be cases in which the surgeon may think it right to divide a fracture perfectly united, but in a vicious position, at any time after the injury, and when the bone can no longer be re-fractured. This may be done either by direct incision¹ or by subcutaneous section, as is done in vicious ankylosis of joints (see below, the section on ankylosis); or, as has been ingeniously suggested by Langenbeck,² the projecting portion of the bone may first be considerably weakened, by boring a large hole through it, and extending this hole by means of a keyhole-saw till only a bridge remains on either side. Then the wound is dressed, and the limb put into a plaster-of-Paris splint, until it has healed, when the weakened part is easily fractured and put straight, and there remains only a simple fracture to treat. Finally, it may be necessary, in some cases, to remove a wedge-shaped piece of bone, including the prominent portion, in order to give the patient a useful limb.³

Painful
union.

The united bones may be in proper position, or nearly so, and yet the limb may be almost useless from inflammation of the bones or neighbouring parts, or from matting together of the tendons or other structures. These complications must be treated on ordinary principles. But there are cases in which large nerve-trunks (e.g. the musculo-spiral, or the brachial plexus) are involved in and compressed by the callus, or by some detached fragment, and so the limb may be paralysed. Cases are on record in which this untoward event has been remedied by cutting away the superfluous bone, or callus; and freeing the nerve-trunk. Such a case was Ollier's,⁴ in which the musculo-spiral nerve was liberated from pressure, and Délens',⁵ in which the brachial plexus and subclavian artery were the parts compressed.

DISLOCATION.

The word 'dislocation,' when used by itself in surgical works, is intended to signify the forcible displacement of one articular surface of a joint from another. Other organs also are subject to dislocation; thus dislocation of the lens and of the testicle are spoken of, but in such cases the name of the displaced organ is always added. Dislocation of joints also occurs as a consequence of disease (pathological dislocation, frequent in the knee and hip), and sometimes as the result of malformation (congenital dislocation). Traumatic or true dislocation may be complete—i.e. where no portions of the two articular surfaces are in contact—or incomplete, when a part of one still remains applied to the articular surface of the other bone. When the bone, besides being dislocated, is exposed by a wound, the dislocation is said to be compound. It is universal in modern surgical works to describe dislocation

¹ See Lister, 'Brit. Med. Journal,' Oct. 31, 1868, p. 462.

² 'Lond. Med. Record,' March 31, 1875, p. 198.

³ See a case by Mr. Heath, 'Clin. Soc. Trans.' vol. x. p. 158.

⁴ 'Gaz. hebdomadaire,' 1856, p. 515. 'New Syd. Soc. Bienn. Retrospect,' 1865-6, p. 294.

⁵ 'Lancet,' Nov. 19, 1881.

as being of the more movable bone, or of that bone which is situated farthest from the trunk, but in the older writers this rule is not followed. Thus Sir A. Cooper described the dislocations of the ankle as being of the tibia and fibula, which are now described as dislocations of the foot. This difference of nomenclature of course reverses the direction in which the part is said to be dislocated, since a displacement which, if described with reference to the leg, is inwards, becomes outwards when the foot is said to be displaced.

There are a few points which ought to be mentioned as concerning dislocations in general before the individual injuries are described. The signs of a dislocation are, loss of the natural shape of the part, loss of the movements of the joint, both active and passive, in different degrees, and alteration of the relations of the bony prominences to each other, together with an absence of the signs of fracture, when the dislocation is pure; but it is not uncommon for the dislocation to be accompanied by fracture of some bony process, or even of the shaft of the bone in the neighbourhood.

General
symptoms.

Having diagnosed the existence of dislocation, the surgeon's aim is to *reduce* it, i.e. to restore the displaced bone to its natural position. As a general rule all dislocations are accompanied by more or less laceration of the capsule of the joint,¹ of some of its special ligaments and of the muscles around it, while the muscles on one side are put on the stretch and those on the other side shortened. After a time the displaced head of the bone contracts adhesions to the other bones and to the parts around, and, especially where there has been much motion of the bones on each other, a kind of new articulation may be formed, while the old articular cavity may be more or less completely filled up. The obstacles to the return of recent dislocations depend on the resistance of the displaced muscles or ligaments, on the interlocking of the bones, or on the interposition of the capsule or some of its accessory structures between the dislocated bone and the cavity to which it is to be returned. Many of these obstacles are more easily overcome by appropriate manipulation than by force, so that dislocations of the hip, for which it used to be thought necessary to exhaust the muscular force by bleeding and antimony, and then to use violent extension by means of pulleys, are now usually reduced under chloroform with extreme facility by simply disengaging the head of the bone from its acquired position, when the muscles at once restore it to its natural one.

Reduction.

In old dislocations the difficulty of reduction depends on the formation of adhesions between the two bones, on the permanent contraction of the shortened muscles, and on inflammatory deposit filling up the old articular cavity, which sometimes renders the return of the bone impossible, and at others even fills up the cavity altogether. The shape of the displaced bone itself also becomes altered by pressure or by inflammation.

As these difficulties increase very speedily in the first week or two after the injury, it is of the greatest importance to recognise the nature of the accident, and apply the appropriate remedy as early as possible. When a dislocation has existed for a very long time it is very doubtful whether its reduction is physically possible, or whether, if it were reduced, the limb would gain or lose in utility.

When a dislocation has been successfully and completely reduced, the after treatment will have to be conducted with great care and judgment

¹ Mr. Eve describes a case of complete dislocation of the shoulder, in which the capsule was not lacerated, but stripped off the scapula together with the periosteum. 'Med.-Chir. Trans.' lxiii. 317.

on the part of the surgeon, for, whereas absolute rest is necessary, on the one hand, to allow the lacerated capsule and muscles to heal, and to prevent the dislocation from recurring ; still, on the other hand, this rest must not be too prolonged, for fear of fibrous adhesions in the joint taking place with contraction and shortening of the capsular and other ligaments, which will necessarily interfere with the freedom of movement, and in some cases, at all events, will be very difficult or even impossible to overcome. Passive motion should, therefore, be employed by the surgeon daily after the lapse of the first few days, the limb between his visits still being kept fixed by means of bandages or other surgical appliances, so as to prevent any incautious movement of the patient producing a recurrence of the dislocation.

Repair of
injuries of
cartilage.

It remains to say a few words as to the method of repair in wounds or fractures of cartilage. The method of union of fractures is best studied in those of the costal cartilages and those of the articular cartilage of the femur, which is so often involved in the fractures which run into the knee-joint. The uniting medium seems to differ somewhat in accordance with the different qualities of the cartilage involved. Thus the costal cartilages, which are naturally prone to ossify, unite very commonly by bone,¹ or by a mixture of bone and cartilage. Fracture of articular cartilage is usually very slow of healing, and the cartilage is found unchanged close to the seat of fracture ; ultimately the breach of surface is usually repaired by a layer of fibrous tissue or by a mixture of fibrous tissue and cartilage.² In wounds of cartilage made for the purposes of experiment on the lower animals Dr. Redfern has found that the resulting changes affect both the cells and the intercellular substance, though only to a slight distance from the seat of injury. They display a very strong tendency to heal without any further destructive changes, and this repair is brought about either by the production of fibrous tissue, or by calcareous deposit leading to calcification of the entire cartilage. Dr. Redfern describes both the cells and the intercellular substance of the injured cartilage as taking part in the production of the fibrous tissue, the intercellular substance fibrillating and becoming replaced by a material exactly resembling white fibrous tissue, while the cartilage-cells increase in size and their nuclei give place to a number of corpuscles. Then the wall of the cell becomes identified with the hyaline intercellular substance and the corpuscles are set free, and while the hyaline substance is becoming fibrillar and forming the white fibrous substance, the corpuscles are developed into the nuclear or elastic fibres.³

From these researches Dr. Redfern concludes that 'uncomplicated lesions of cartilages (especially such as have been artificially produced in the lower animals) manifest a very decided tendency to spontaneous cure by the pro-

¹ In the Museum of St. George's Hospital are three specimens of fracture of costal cartilages (Ser. I. Nos. 67, 68, 69), all united by bone. Mr. Poland refers to three in St. Bartholomew's Hospital Museum, in one of which the union is entirely and in another partially bony, cartilage being mixed with the bone ; in the third the fracture is repaired by the growth of a new cartilaginous substance.

² In the Museum of St. George's Hospital (I. 193) is the preparation of a fracture running into the knee-joint, received twenty-eight days before the patient's death. 'On the articular surface a thin layer of firm fibrine, of a light brown colour, is interposed between the cartilaginous margins of the fracture, the cartilage itself having as yet undergone no change.' A preparation, exactly similar to this, is figured in the section on fracture of the femur.

³ Redfern. *Abnormal nutrition of cartilage*, pp. 67 et seq.

duction of fibrous tissue, or by calcification of the whole cartilage left after the injury ;' and that the 'diseased action arising from circumscribed destruction of the articular cartilages of the lower animals evinces no tendency to extend to the remaining parts of these textures, nor to involve other structures, and lead to serious disease of the joint.'

Uncomplicated lesions of cartilages are of course very rare in the human subject, but the examination of specimens such as that above referred to from St. George's Hospital Museum leads us to believe that Dr. Redfern's conclusions are true in the main when applied to the human subject ; that is to say, that cartilage is prone to repair, and that the disease produced in it by traumatic injury rarely extends far from the part injured.

CHAPTER VII.

INJURIES OF THE HEAD.

Serious results sometimes follow trivial injuries.

INJURIES of the head are matters of equal importance and interest. It is an old and good rule in surgery 'never to look lightly on any injury of the head, however trifling it may appear.' Very grave anatomical lesions may have been produced by injuries which appear trivial. Cases are recorded in which a weapon has passed deeply into the brain, through the papery bones of the orbit, and has left a fragment there, and the man has gone about his business thinking he had only received a scratch on the eyelid, till inflammation of the brain has set in, and the foreign body has been found after death.¹ So, again, a slight tap on the skull may possibly cause rupture of a large vessel or laceration of the brain, followed by fatal hæmorrhage or inflammation. And again, lesions really very slight in themselves may be followed by the most alarming and even fatal consequences. Every one must have seen, both in public and private practice, cases in which very slight injuries of the head have set up frightful attacks of erysipelas, or have been followed by brain-symptoms quite disproportionate to their apparent gravity. Therefore, though these unfortunate cases are comparatively rare, they must be borne in mind as an argument for caution in the treatment and some reserve in the prognosis.

Classification of the injuries.

Injuries of the head may be thus divided:—i. Simple contusion of the soft parts. ii. Scalp wounds. iii. Contusions of the skull. iv. Fracture of the skull, simple or compound, and either of them with or without depression of the fractured bone. v. Injury of the brain and its membranes. vi. Injuries to the nerves.

Complications.

The inflammatory complications of such injuries are erysipelas and diffuse inflammation of the soft parts, inflammation of the brain and its membranes, and hernia cerebri.

I. *Contusion* of the scalp may be either bruising of the skin and tissues superficial to the aponeurosis of the occipito-frontalis, or may result in extravasations of blood beneath the aponeurosis, in the loose cellular tissue between it and the pericranium, or beneath the pericranium, between it and the bone. The superficial bruise requires no special description, and differs in no respect from a bruise in any other part of the body. Extravasation of blood between the aponeurosis and pericranium gives rise to a bloody tumour (hæmatoma) which, especially in children, may extend over the whole, or over one side of the head; from the points of attachment of the occipito-frontalis in front and behind, and laterally as low as the zygoma. Fortunately the size of the vessels in the sub-aponeurotic tissue is not great, and therefore such huge extravasations as this but rarely take place. When smaller, the chief point of interest about them is that they are liable to be mistaken for depressed bone. The collection of blood is bounded by a hard ridge or

¹ Several such cases have been published; in one case it was the end of a walking-cane with which a soldier was fencing with his comrade; in another the ferule of an umbrella which a testy old gentleman poked into the eye of a man who ran against him in the street.

border of condensed tissue and coagulated blood, which somewhat resembles to the touch the edge of a fracture with depression. But generally the contusion may be recognised as such by the following characters: the ridge is elevated above the level of the neighbouring sound skull, its edge is somewhat rounded, its outline regular and usually crescentic, and, by pressing the finger-nail upon it, an impression may perhaps be made. In fracture with depression, on the other hand, the ridge which appears elevated is really on the same level as the rest of the skull; its margin is sharp and irregular, and its direction very variable. Extravasations of blood beneath the pericranium are usually met with in the infant, as the result of some injury received during parturition. They are termed *cephalæmatomata*, and usually appear within twenty-four hours of birth. They are always confined to one bone, generally the parietal, because of the connection of the pericranium to the sutural ligament, and are soft, elastic, fluctuating tumours. The swelling is usually harmless and painless, and for the most part disappears in from one to two months after birth. The only question of treatment which occurs is in the large extravasations of childhood. Here evaporating lotions will generally be all that is necessary, and the extravasation will probably be absorbed in time. But in a case where no perceptible improvement followed from prolonged expectant treatment, it would be right to draw off the fluid with an aspirator. In the event of suppuration taking place, free incisions at the most dependent points, and thorough washing out of the cavity with some antiseptic fluid, must be at once resorted to. Drainage tubes must then be introduced and every means tried to maintain the wound in an absolutely aseptic condition.

II. Scalp wounds may be divided into two classes; viz., those in which the bone is not exposed, and those in which the wound divides not only all the other soft structures, but the pericranium also, and exposes the surface of the bone. The distinction is a useful one, inasmuch as these latter cases are much more serious injuries, and are often followed by much more serious consequences, for in them the bone is not only exposed, but very often cut, bruised, or rasped to a greater or less extent. It is to this injury of the bone that these cases of scalp wound owe their importance, and they will therefore be considered in the next section, with cases of contusion of the bones of the skull, and we shall confine our attention in this place to cases of scalp wound where the bone is not exposed.

Scalp wounds, like wounds in other soft parts, may be incised, contused and lacerated, punctured, or large flaps may be torn down in severe cases. The most common form of scalp wound is the contused one, since they are usually produced by some blunt instrument. It should be remembered, however, that a blunt instrument may produce in the scalp a wound which has altogether the appearance of an incised wound, as this may be of importance from a medico-legal point of view. As a rule scalp wounds do not gape much, and though the bleeding may be free, on account of the vessels being contained in a dense fibrous material, and therefore unable to contract and retract perfectly, it is usually entirely under the control of the surgeon. The most severe and often frequently repeated hæmorrhage occurs in those cases where some artery has been partially divided. The free division of the vessel will usually insure a complete cessation of the hæmorrhage on the application of a little pressure. If the arteries are too much contused to be tied or twisted they can easily be compressed, or, in the last resort, be commanded between an acupuncture-needle thrust in below them and a

ligature above. Bleeding having been stopped, and all dirt and foreign bodies carefully and gently removed, the wound must be united. There is an old traditional horror of sutures in scalp-wounds which seems to me, to say the least, exaggerated; and I never hesitate to use silver sutures when there is any difficulty in keeping the wound in apposition. There is no necessity for putting them in deeply, so as to wound the tendon, and therefore no justification for doing so. The wound should then be so dressed as in the opinion of the surgeon is best calculated to produce its rapid union (see DRESSING OF WOUNDS): for in every scalp-wound, whether bone be exposed or no, and whether that bone be fractured or no, rapid union is the main point by which the patient's safety is insured.

Complica-
tions—
erysipelas.

The most common complication of scalp-wounds is erysipelas, either of the common or of the cellular variety. Cutaneous erysipelas is, I think, the rarer form. It extends to the face, and requires only the ordinary treatment. The treatment of the cellular form is a more serious problem. The inflammation originates in lesion of the cellular tissue between the tendon and the pericranium, and extends often with great rapidity over the whole head, causing immense œdema, and leading ultimately to sloughing both of the scalp and pericranium.¹ It begins with puffiness and slight redness around the wound, but as the inflammation is almost confined to the cellular tissue the redness is not usually at all vivid. The œdema extends from the wound, accompanied with pain in the head, and general fever, ushered in usually with rigors, which may recur more or less frequently; the pulse is rapid and often weak: the tongue white, with glazed edge. Matter forms after a day or two, and the bone is often exposed in places by the destruction of the pericranium. Burrowing of matter as the result of scalp-wound is easily to be distinguished from the œdema and boggy feeling of cellulocutaneous inflammation, since it is confined to the neighbourhood of the wound and gives rise to far less severe symptoms. Nothing here is required usually, except to give an exit to the burrowing matter, and perhaps pass a drain through from the wound to the opening so made.

Patients attacked with cellulocutaneous erysipelas generally, or at any rate frequently, are those whose constitution is broken down by intemperance, privation, or disease, and such a case is therefore to be looked upon always with anxiety. They seldom bear depletion, or even deprivation of nourishment or stimulants, so that anything like copious loss of blood is to be deprecated. Still, if the parts are tense and the œdema is rapidly advancing, it is absolutely necessary that incisions should be made, and that boldly and decisively.

When incisions are manifestly necessary they must be made boldly down to the bone, and to a sufficient extent to ensure the relaxation of all the tense tissues. But no one incision should be of any great length, since otherwise some large vessel must necessarily be injured—about $1\frac{1}{2}$ to 2 inches is the limit for each incision. They should run directly from before backwards, and any large vein which is seen under the skin should be avoided. If much arterial hæmorrhage occurs, it must be checked before the patient is left.

The general treatment must be of a stimulating and supporting nature. Tonics and easily digestible nourishing food and stimulants are generally indicated from the first. In fact, the general treatment must be conducted on the principles laid down in the section on erysipelas.

¹ In one case where no incisions were made I saw the whole vertex of the skull exposed by sloughing as cleanly as if the man had been scalped by a Red Indian.

III. Scalp wounds where the bone is exposed are usually attended with some injury to this structure, the bone being also cut, bruised, or rasped to a greater or less extent. Contusion of the cranial bones may, however, occur without any external wound, and may be followed by inflammatory trouble; they are not, however, of such importance as when the bone is exposed, for then there will be the additional risk of septic infection. The consequences of this injury to the bone may be—1. Necrosis. 2. Ostitis. 3. Inflammation of the veins of the diploë and pyæmia. 4. Inflammation of the brain and its membranes.

Contusions
of the
skull.

1. When the bones of the skull have been exposed by a wound which has separated the pericranium from them to a greater or less extent, the external table of the portion of skull thus exposed is deprived of its blood supply, and may therefore perish, and will then exfoliate as a thin plate of bone, consisting of the external table only. Or a small portion of the bone may necrose, and the wound heal, with the exception of a sinus, which will continue discharging until the sequestrum is removed or got rid of, when it will speedily heal. It is by no means necessary that, in every case where the pericranium is stripped off, the bone should perish. The occurrence of necrosis will probably depend on the injury done to the bone itself. If it is about to die, the bone will be white and dry, but if, on the other hand, its vitality has not been destroyed, it will be seen to be of a pinkish hue, and shortly minute red spots will appear on its surface, which will be speedily developed into granulations, and the bone become covered with a granulating layer from which new periosteum will be formed. In these cases of necrosis there will be no constitutional symptoms, or if there are any they will be of a very slight character; there is merely local pain and tenderness, with discharge from the wound, while the bone slowly and gradually exfoliates.

Necrosis.

2. Injury of the bones of the head may be followed by inflammation, which may result either in sclerosis or extensive necrosis. The disease is usually very chronic. The patient may have apparently quite recovered from the injury, when he will begin to complain of severe and persistent pain in the head, especially worse at night, and of a dull aching character. This may be followed, after a considerable lapse of time, by symptoms of brain irritation; as, for instance, fits of an epileptiform character, or there may be no symptoms at all. As in the case of a man whose skull is in the Museum of St. George's Hospital, who only noticed the increase in the size of his head by finding difficulty in getting on the hat he was in the habit of wearing. The disease consists essentially in a chronic inflammation of the bone tissue, with inflammatory effusion, which either undergoes ossification and produces the condition known as sclerosis, which will be described in another chapter, or else terminates in necrosis, which differs from the necrosis previously described, which is local, and arises simply from a deprivation of the tissue of its blood supply; for here it is due to inflammatory changes, and may spread far and wide, and affect both or either of the tables of the skull.

Ostitis.

3. Osteo-phlebitis is an occasional consequence of scalp wounds, attended with contusion or injury of the bones of the skull. It is due to septic infection of the diploic veins, which are particularly disposed to it on account of their situation in dense structures, which prevent their closing as in soft parts. This inflammation of the diploic tissue is liable to be followed by pyæmia, or the inflammation may extend through the inner table of the skull to the membranes of the brain. If in a case of scalp wound, where the bone has

Inflamma-
tion of the
veins of
the diploë.

been exposed, it becomes dry and white and the wound ceases to secrete pus, the patient at the same time suffering from repeated rigors, with a high intermitting temperature, the presence of osteo-phlebitis and pyæmia will be indicated, and the case will probably terminate fatally.

Inflamma-
tion of the
brain and
its mem-
branes.

4. All injuries of the head, of whatever kind, may be followed by inflammation of the brain or its membranes. The consideration of this subject will be left therefore until the other forms of injury of the head have been discussed. There is, however, one form of intra-cranial inflammation, which directly follows contusion of the bones of the skull, which it seems appropriate to mention in this place. I mean localised suppuration between the bone and dura mater or in the sub-dural space, limited to the seat of injury to the bone. These cases are very rare, and in the vast majority of instances, where the inflammation extends through the bone to the membranes of the brain, the arachnoid is extensively inflamed and the surface of the brain covered with a quantity of puriform exudation. These cases of localised suppuration were first carefully described by Pott, who records eight cases which occurred under his own observation.¹ The cases, however, of this sort in modern surgery are not so common.² It is important, however, to bear in mind that such a condition may exist, as it is obvious that they are capable of relief by trephining, whereas in the cases of diffused suppuration over the membranes little good can be expected from the employment of this means of relief. In five out of the eight cases recorded by Pott, the application of the trephine was followed by recovery. The sign by which the presence of pus between the bone and dura mater is to be recognised is the presence of a soft, flattened, circumscribed swelling, known as 'Pott's puffy tumour,' at the seat of injury. The formation of this, or, if there is a scalp wound, the same appearance of a flattened puffy swelling of its edges with a dry state of the bone, would indicate to the surgeon the probability of the pus being between the bone and dura mater in any case of injury of the head in which the general symptoms lead to the diagnosis of abscess somewhere within the cranium, and would justify him in at once trephining for its relief.

Fractures
of the
vault of
the skull.

IV. We come now to fractures of the skull, divided into those of the vault and those of the base. The chief varieties of fracture of the vault are simple fissures, starred and comminuted fractures, fractures with depression of the entire thickness of the skull, fractures with depression of the outer or of the inner table only, and fractures with elevation of the fractured portion. In young subjects it is said that the skull may be indented or driven in (as any soft substance might) without any fracture, but this is doubtful.³

Any of these forms of fracture may be either simple or compound. In the injuries which we usually meet with in civil practice fissured fractures frequently spread from the vertex far into the base of the skull, and sometimes travel vertically round the whole cranium, so as to separate the anterior

¹ Injuries of the Head, 'Chirurgical Works,' vol. i. pp. 38 et seq.

² See Holmes, 'Brit. Med. Journ.' Oct. 16, 1858.

³ I mean that it is doubtful whether the indentations which are occasionally found in the skulls of children are not always accompanied by some amount of fracture. The occurrence of such indentations and their gradual disappearance is indubitable. See in Mr. Le Gros Clark's work, p. 24, a very characteristic case in a baby six months old caused by falling on a stone. 'The indentation was oval, about three-quarters of an inch deep in the centre; the end of the thumb might easily have been buried in it; it presented no sharp edge to the touch.' There were no head symptoms. Mr. Clark saw the child several years afterwards, and there remained no trace of the injury.

completely from the posterior part. Compound fractures may be said as a rule to be more often of limited extent than simple.

Fractures with depression of one table only, and elevated fractures, are rare. The other varieties of fracture of the skull are of constant occurrence. Fractures with depression of the outer table only are best exemplified by those which occur in the frontal sinus, where a great depression may exist

Depression
of one table
only.
Fracture
of frontal
sinus.



FIG. 38. A fracture passing vertically round the skull, so as to divide it into two portions, anterior and posterior. The line of fracture can be traced from the vertex, where it follows pretty nearly the course of the coronal suture to the base where it becomes comminuted, the chief branch passing through the body of the sphenoid bone and extending into the sphenoidal fissure on the left side, while another large branch traverses the basilar portion of the occipital bone, just in front of the foramen magnum. The petrous portion of the left temporal bone is quite isolated. *a.* The foramen magnum. *b.* The basilar portion of the occipital bone. *c.* The foramen ovale. *d.* The sella turcica.—St. George's Hospital Museum, Ser. i. No. 6.

in the outer wall of the sinus without its inner wall having been in any respect interfered with. Such cases are easily known by the free escape of air out of the sinus, leading to considerable emphysema, and by the absence of brain-symptoms, in spite of the extensive depression.¹ Fractures with depression of the internal table only are rare, and their diagnosis very obscure. The Museum of St. George's Hospital contains two very well-marked specimens;² and there is another specimen showing the skull-cap, from which a portion of the depressed inner table had been removed a year after the accident, but the

patient died of arachnitis. This injury may be suspected, though it cannot be exactly diagnosed, from the continuance of constant pain in the part, accompanied with symptoms of imperfect compression of the brain, or followed by low inflammation of the membranes; and in such cases the trephine may be applied over the seat of injury, if the symptoms are grave enough in the judgment of the surgeon to warrant so serious a measure. The accidents which usually give rise to this injury are blows or cuts with a moderately sharp substance, a sabre-cut, a fall on a stone, the blow of a piece of slate, brick, shovel, &c. In almost all cases there is a fissure in the external table, but the internal table is said to have been fractured alone. Fractures with elevation of the fractured part can only be produced by direct wound, and are at once obvious.³ The importance of the injury depends generally on the lesion of the brain or its membranes by the wound. The portion of

Elevated
fractures.

¹ A very well-marked case of fracture of the outer table only, from the blow of a bludgeon, in which the fractured portion ultimately separated, is related by Mr. Le Gros Clark, p. 91.

² Series I. Nos. 7 and 8. One of these is figured in Sir P. Hewett's article on 'Injuries of the Head,' 'Syst. of Surg.' 3rd ed. vol. i. p. 581.

³ A good illustration of this rare form of fracture, also from St. George's Hospital Museum, will be found in Sir P. Hewett's essay, p. 580.

bone turned up will be easily bent down again if it interferes with the union of the wound, or if it breaks in the attempt it may be removed.

Fracture
and other
injuries by
'contre-
coup.'

We frequently hear of fracture of the skull by 'contre-coup,' but it seems undeniable that, as Mr. Le Gros Clark has pointed out (*op. cit.* p. 102), this expression is generally employed in quite an erroneous sense. Strictly, it ought to mean that, the skull being struck at a given point, fracture occurs at the point diametrically opposite, while no force is applied to the skull in the latter situation. This appears to be quite unproved. If the vertex be struck, fracture often takes place at the base and not at the vertex; or if one side of the head be struck fracture often takes place at the other; but in the former case the injury to the base is due to the skull having been made to impinge forcibly on the occipital condyles; and in the latter, as far as I have been able to discover, it has always been the case that the opposite side of the skull has been driven against an obstacle; so that both are instances really of direct force. Again, when a blow is struck on one side of the vertex of the skull, the opposite side of the base of the brain is often lacerated, but this is obviously caused by the brain having been driven down on to the rough base of the skull. The term is, therefore, speaking accurately, quite incorrect, but it may be retained as having now come into general use to express the fact that a blow at one part of the skull often produces its main results at the other end of the axis of the cranium—a fact which is of considerable practical importance.

Diagnosis
of fracture.

Excepting a few cases of comminuted fracture, in which crepitus is to be felt, or a fragment is movable,¹ the only diagnostic sign of a simple fracture of the skull is the depression by which it may be accompanied. If no such depression exists there is no means of knowing, in any case of concussion or other injury, whether the bone is or is not also broken. Nor does it much matter, for though, in popular language, a fracture of the skull is represented as a very grave injury—and rightly so, because fractures of the skull are usually accompanied by injury to the cranial contents—it should be remembered that it is this concomitant injury which alone gives them their gravity, and that in themselves fractures of the skull are hardly more serious than fractures of any other bone. The skull is richly supplied with blood, and simple fractures of the vertex, unaccompanied by any other lesion, unite very kindly.

In examining the skull for depression care must be taken not to confound the depression so often found in the centre of a lump of extravasated blood with the depression of a fracture (see page 143). There are also some rare cases in which an injury has been received over a portion of the skull in which either the whole cranium or the external table only has been deficient from congenital malformation or from atrophy, and the edge of the deficient part has been mistaken for that of a fracture. The diagnosis of compound fracture is generally obvious; care must, however, be taken not to mistake a suture for a fissure; this may easily be done when the sutures are irregular, as in the instance of numerous Wormian bones.

The treatment of an undepressed fracture, whether simple or compound, consists merely in precautionary measures. In compound fracture everything should be done to promote the immediate union of the wound, and very often the fracture will heal as uninterruptedly as a simple fissure. The rest of the

¹ In a circular fracture of the vault and base of the skull described and figured by Mr. Hutchinson (*op. cit.* Pl. xxviii.) crepitus was thought to be detected during life.

treatment consists merely in watching for and treating any cerebral symptoms which may arise.

Simple depressed fractures ought to be elevated by operation when accompanied by symptoms of compression or of irritation of the brain, but not

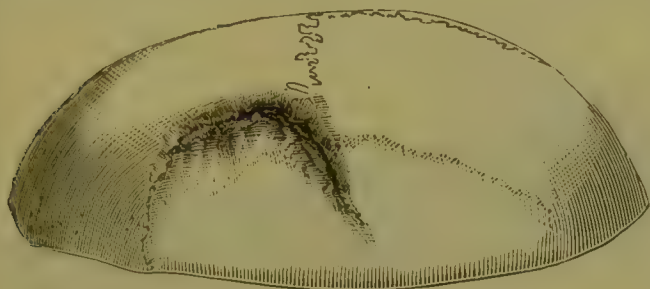


FIG. 39. An old depressed fracture of the skull soundly and perfectly cured without trephining. The fracture is seen to be chiefly of the frontal bone, extending slightly into the parietal. Its depth is equal to that of the whole thickness of the skull, and the length of the fissure is at least four inches. On the inside of the skull the angle of the depressed portion projects as a spike or thorn of bone which had penetrated the dura mater, and was lodged in a little pit or depression in the surface of the brain.

Nothing is known about the original injury, except that the man was in the Middlesex Hospital in the year 1853, fourteen years before his death, on account of some injury to his head; and that he had been subject ever since to violent paroxysmal attacks of pain in the head. The records of the Middlesex Hospital, however, contain no notice of the case.—Museum of St. George's Hospital, Ser. i. No. 244a.

otherwise, and in practice cases will often be met with where the surgeon will require all his acumen to determine whether the symptoms of cerebral irritation which exist do or do not depend on the depression of bone. When this depression, however, is considerable and there are cerebral symptoms, the operation is indicated.

In compound depressed fracture most surgeons are in favour of extending the province of operation so far as to say that they ought

always to be elevated, whether symptoms are present at the moment or no. But this is a rule which is by no means universally adopted. Cases of depressed fracture, both simple and compound, often unite, and the patient recovers without operation. This is illustrated by the accompanying figure (39) and by some striking preparations of sabre-wounds of the skull in the Museum of the College of Surgeons. For my own part, if the depth of the depression is slight, and especially if its extent is also considerable, I have no doubt that in the absence of symptoms it is best left alone; whilst under opposite circumstances (i.e. the deep depression of a small piece of bone as shown in fig. 52) it might be better to elevate it; but then such a depression will almost certainly produce cerebral symptoms. And depressed compound fractures with symptoms should no doubt always be elevated. On the whole, therefore, the treatment of compound and simple fractures would not vary so much as used to be the rule. There is, no doubt, somewhat less hesitation in applying the trephine when the fracture is already exposed in a wound, but the depth and the extent of the depression are far more important considerations. The more a fracture approaches the 'punctured' form the more is trephining indicated. I think there is no doubt that surgeons now look with less apprehension on the use of the trephine or Hey's saw for the elevation of depressed bone than they did formerly, and are therefore more disposed to interfere, even when there are no symptoms. I may refer the reader to two interesting papers by Mr. Muskett, of Sydney,¹ referring to twenty-two cases of depressed fracture treated by immediate operation with twelve recoveries.

Fractures of the base of the skull are in the great majority of cases caused by indirect force, and are extensions downwards of fractures of the vault. Sometimes, however, they are caused by direct violence. This occurs most commonly in wounds of the orbit. Here it has frequently happened that a

Fractures of the base.

Wounds of the orbit.

¹ 'Australian Medical Gazette,' July 1883 and Dec. 1886.

slight injury, such as the thrust of a foil or a parasol or some weapon, has inflicted an apparently trivial injury on or below the eyelid (generally the upper), and that the accident has been taken little notice of, until some days afterwards symptoms of cerebral inflammation have appeared and have proved rapidly fatal. On post-mortem examination the weapon has been found to have passed through the papery upper wall of the orbit into the brain, and a fragment has not unfrequently been found lodged in the cerebral substance. In other cases, though the brain has not been wounded, the cavernous sinus has been laid open, giving rise to fatal hæmorrhage, or to lesions of the orbital nerves, or to orbital aneurism.¹ All such cases, therefore, should be carefully examined at first, and sedulously watched afterwards. Other and rarer instances of direct fractures of the base of the skull are found, as, for example, in the preparation from St. George's Museum, figured in Sir P. Hewett's essay, where

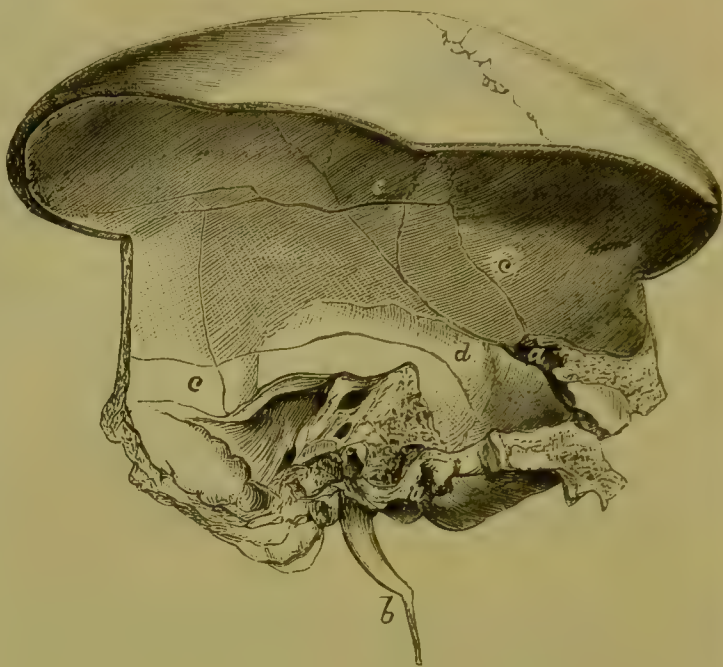


FIG. 40. A fracture of the skull in which some of the large branches of the middle meningeal artery were cut across, causing extravasation of blood between the bone and dura mater. A portion of the vault of the skull has been left on, in order to show that this fracture, contrary to what is usual in such cases, does not affect the vertex. It is of a tri-lateral shape, with a horizontal and two vertical branches, *c, c, c*. Some of the large grooves for the meningeal artery, *d*, are cut across, but not in the usual position. The main trunk of the middle meningeal artery was divided, and there was extensive extravasation of blood between the bone and dura mater, as well as laceration of the cerebral substance. Yet there was no paralysis as far as could be made out, though the patient was completely insensible and frequently convulsed. *a, a* refer to sections of the outer wall of the orbit, separated by the sphenomaxillary fissure; *b*, to the styloid process.—St. George's Hospital Museum, Ser. i. No. 200.

the condyle of the lower jaw is driven through the base of the skull; but the vast majority are indirect fractures, sometimes of the form of simple fissures, at other times branching in various directions. They are either confined to a single zone or fossa of the base, or they implicate two or three fossæ at the same time.² The great majority of these fractures pass through the middle fossa. As stated above, the fracture usually extends into the vertex, being sometimes a branch of a fracture originating in the vault; sometimes, but more rarely, it originates in a shock transmitted through the spine to the base of the skull, and spreading up into the vertex. In some cases, as in that which furnished figure 40, the fracture, though of considerable extent, may be confined to the base, but this is decidedly unusual in indirect injuries.

¹ See 'Lancet,' 1873, vol. ii. p. 143, for a reference to some of these cases.

² Sir P. Hewett refers to the records of St. George's Hospital for ten years, comprising 64 cases of fracture of the base. Out of these there were 25 in which the line of fracture was confined to a single fossa; the anterior in 5 cases; the middle in 14; the posterior in 6. There were 29 cases where 2 fossæ were implicated, viz. the anterior and middle in 14; the middle and posterior in 15. In the remaining 10 the fracture traversed all 3 fossæ. Thus the middle fossa was implicated alone or with the others in 53 out of 64 cases.—'Syst. of Surg.' 3rd ed. vol. i. p. 589.

These fractures, occurring as they do in severe injuries of the head, are therefore usually accompanied by the ordinary cerebral symptoms. Irrespective of these the only symptoms of fracture of the base are the escape of the contents of the cranial cavity, or injury of the nerves which pass through the foramina at the base of the skull. Now, the contents of the cranial cavity are blood, subarachnoid fluid, and brain-matter. The brain-matter very rarely indeed exudes from a fracture of the base. I have seen, however, a case in which hernia cerebri took place into the meatus auditorius, and a preparation showing a hernia cerebri in the meatus is here figured. When present, this symptom is of course decisive of the existence of fracture. But the usual symptoms are either extravasation of blood or escape of watery fluid.

Symptoms
of fracture
of the base.



FIG. 41. A, the external and, B, internal view of a preparation in which hernia cerebri took place into the external auditory meatus eight days after a gunshot wound. The case is related by Mr. Cæsar Hawkins, 'Contributions to Surgery and Pathology,' vol. i. p. 18. St. George's Hospital Museum, Ser. viii. No. 13.

In fractures of the anterior fossa the blood is extravasated at first in the deep cellular tissue of the orbit, and makes its way forward till it appears under the ocular conjunctiva and the lids.¹ This extravasation is distinguished from that of ordinary black-eye by its being less in the lids, considerable in the ocular conjunctiva, and increasing as it passes backwards out of sight. The reverse is the case in a simple bruise. Blood may also pass through the body of the sphenoid bone into the nose, as it may also in fracture of the middle fossa. Persistent epistaxis, therefore, is sometimes met

¹ Fissured fracture of the roof of the orbit is met with frequently, according to Mr. Hutchinson (op. cit. Pl. xxix. fig. 3), in the post-mortem examination of cases in which there has been no symptom of this particular lesion.

with in fractures of the base, or hæmatemesis occurs from the blood having been swallowed and rejected by the stomach.

The more common hæmorrhage, however, in fractures of the middle fossa is from the ear, the membrana tympani being usually lacerated in such injuries, whereby a way is afforded for the blood to pass out from the lateral sinus, or any other large vessel in its neighbourhood which may have been wounded in the fracture. Bleeding from the ears is accordingly a valuable sign of fracture of the middle fossa of the base of the skull, when copious and long-continued; though it cannot be said to be absolutely diagnostic of the injury, since considerable bleeding has been known to occur in injuries involving only the ear itself. Blood may also pass into the pharynx and nose, causing hæmatemesis and epistaxis, which, however, may have so many other sources that they can only very rarely assist much in the diagnosis. In some rare cases extravasation of blood behind the wall of the pharynx is found.

In fractures of the posterior fossa blood may be extravasated in the neighbourhood of the mastoid process, in the occipital region, or at the side of the neck, and such extravasation may become a valuable sign of fracture in cases where the soft parts are known not to have been bruised. Tenderness to pressure over the mastoid process is sometimes observed in such cases.

Serous discharge in fracture of the base.

But the most striking symptom of fracture of the base of the skull, and one which under certain circumstances is really decisive of the nature of the injury, is the discharge of serous fluid. This occurs, though very rarely, also in fractures of the vertex,¹ and it has been known to take place through the nose, but in all ordinary cases the discharge is from the ears. When, immediately after the injury, a copious discharge of watery saline fluid—i.e. fluid containing only the faintest trace of albumen²—is found issuing from the ear, there can be no question that there is a fracture of the base of the skull cutting the meatus auditorius internus across, and thus laying open that prolongation of the arachnoid membrane which accompanies the

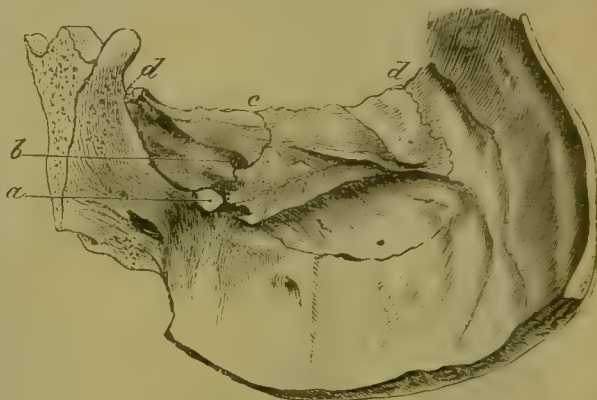


FIG. 42. Part of the base of the skull, showing a line of fracture which traverses the internal auditory meatus. The principal fracture formed the upper boundary of the piece of skull here depicted. At the point *c*, a branch ran down through the internal auditory meatus, *b*, into the jugular foramen, *a*. *d, d* mark the line of the suture. The patient had fallen downstairs, striking one side of his head. He was admitted in a state of partial insensibility, bleeding from the opposite ear and from the nose. Next day a copious watery discharge commenced from the ear, and continued till his death, which took place three days after the accident, from suppurative inflammation of the cerebral membranes. Small extravasations of blood were found in the anterior pillars of the fornix, and on the under surface of both middle lobes of the brain.—St. George's Hospital Museum, Ser. i. No. 243.

¹ Mr. Lucas, in 'Guy's Hospital Reports' 1876, has an interesting account of a case of fracture of the skull in a child followed by a collection of cerebrospinal fluid in the scalp, and in a subsequent paper in the same series for 1878 he relates the post-mortem examination of this child; and again, in a further paper, in the volume for 1881, he pursues the subject and gives other cases, and in a review of the whole matter argues (1) that large collections of cerebrospinal fluid beneath the scalp after fracture of the vertex only occur in children; (2) that when cerebrospinal fluid escapes from the vertex, in quantity, the ventricular cavity has been laid open.

² 'The absence, except in small quantity, of albumen, and the presence of an excess of chloride of sodium in the cerebrospinal fluid, has been repeatedly shown by analysis. —Le Gros Clark.

seventh pair of nerves down the meatus, whereby the subarachnoid space is laid open. For no other cavity, except perhaps the ventricular, exists in which there is any collection of such fluid.¹ But when after an injury to the head, followed by bleeding from the ear which has lasted more than a day, a watery (or rather colourless) discharge follows, which contains more or less of inflammatory products, the inference is not so clear, for such dis-



FIG. 43. Fracture of the anterior fossa of the skull, united. The patient died of erysipelas two months after the injury. The fracture traversed the anterior and middle fossæ of the skull. At *a* is seen the line of the fracture traversing the anterior fossa. The union here is very perfect. In other parts a considerable deposit of vascular porous new bone is found around and between the edges of the fracture. *b* shows a mass of partly decolourised blood clot, mixed with organised fibrine on the outer surface of the dura mater, corresponding to the fracture.—From the Museum of St. George's Hospital, Ser. i. No. 34.

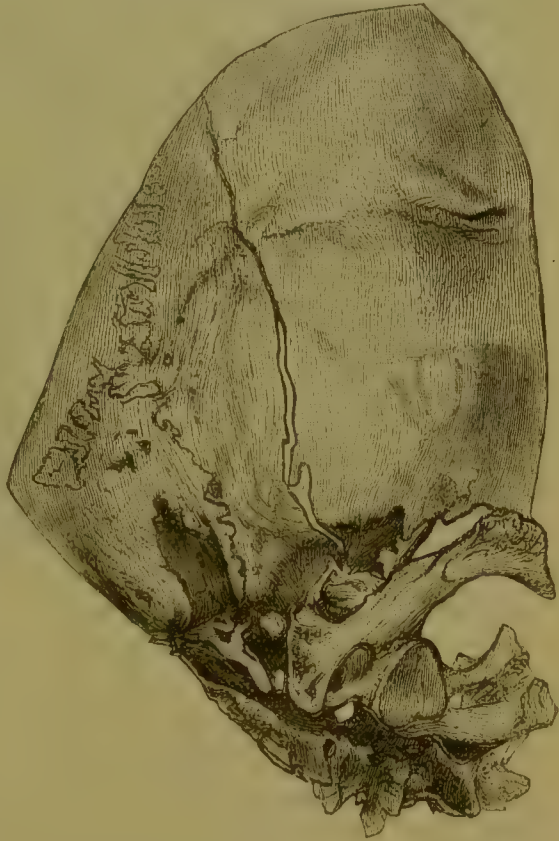


FIG. 44. Union of an old fracture of the posterior fossa of the base of the skull. The accident had occurred three years before death. On post-mortem examination the line of fracture was found to commence at the upper part of the occipital bone, and its upper half has been completely united and is seen on the outside of the skull as a mere groove in the solid bone. On the inner surface the bone was found thickened and vascular at this part, from deposit on its internal surface. The lower half of the line of fracture is not united, but a distinct fissure is left which (as seen in the engraving) is perfectly open in the macerated bone, the margins being thinned and rounded off by absorption. In the recent state this fissure was completely filled by fibrous tissue. Complete bony ankylosis had taken place in the joint between the atlas and occiput, and the lateral sinus was obliterated at its termination ('Path. Soc. Trans.' vol. vii. p. 282).—St. George's Hospital Museum, Ser. i. No. 36.

charges may be furnished by the lining membrane of the external meatus only, or by that of the tympanum, and have been known to occur in cases

¹ There seems some possibility that the descending horn of the lateral ventricle may in some cases have been broken into; and cases which support this belief may be found quoted in Sir P. Hewett's essay, p. 597. Dr. Moxon believes that the fourth ventricle is sometimes injured. (Wilks and Moxon, 'Path. Anat.' 2nd. ed. p. 38.) In Mr. Lucas's case the child died two years after the injury, in consequence of acute inflammation of the membranes. The post-mortem examination showed that the cerebrum had been lacerated into the lateral ventricle, and that the swelling under the scalp was formed by the dilated ventricle.

in which it has been proved by dissection that there was no fracture of the skull whatever.¹ Such discharges, however, are far less watery than those which consist of the cerebrospinal fluid, and they can never occur *immediately* after the injury, though they may commence after a short interval.

Lesions of the nerves which issue from the base of the brain are tolerably often present in fractures of the base; and the paralysis of the nerves, especially those of the seventh pair, is a symptom strongly confirmatory of the diagnosis, though, as will be seen in the sequel, paralysis of these nerves may also result from ecchymosis into their substance, and probably from inflammation following an injury of any kind; so that the symptom is not in itself unequivocal.

Union of
fractures
of the base.

Fracture of the base of the skull is by no means necessarily fatal.² Excluding very many cases in which all the symptoms have existed, but the patient has recovered, so that the diagnosis has not been absolutely certain, we have ample anatomical proof that such fractures do get well,³ and that they are not insusceptible of union, though in the parts of the base where the bone is very thin and the foramina large the union is apt to be irregular, and the edges may often be found somewhat absorbed, forming a chink or fissure. Figs. 43-45 furnish illustrations of united fracture in each of the fossæ of the skull, from the Museum of St. George's Hospital.

No treatment is required for the fracture of the base beyond that which the concomitant injury of the brain demands.

Lesions of
the brain.

V. We must now pass on to those symptoms which accompany injuries of the brain itself.

These are usually classed under two heads—Concussion and Compression



FIG. 45. Fracture of the left temporal bone, extending into the base of the skull. The patient died two months afterwards, from a different cause. The part of the bone here represented is the squamous portion. 'The edges of the fissure have been so thinned away by absorption that an opening in the bone is formed $1\frac{1}{2}$ in. in length, tapering to its extremities, and $\frac{1}{2}$ in. in breadth at its centre. At the points where the edges of the fissure are in contact (between *a* and *b*) no bony union has taken place, as ascertained by Mr. Tomes on endeavouring to make a section for the microscope.' See Mr. Gregory Forbes in 'Lancet,' vol. i. p. 580, 1849.

¹ See in the 'Path. Soc. Trans.' vol. vi. p. 22, a case reported by Mr. Gray, in which serous discharge followed upon injury to the tympanum, and inflammation of the lining membrane of the tympanum and mastoid cells, but without any fracture of the temporal bone. And in the same series (vol. xii. p. 159) a case by myself, where serous discharge was produced by a fracture of the neck of the condyle of the lower jaw perforating the meatus, but without any injury to the skull whatever.

² Dr. Lidell has recorded, in the 'Am. Jour. Med. Sc.' April 1881, 135 cases of fracture of the base of the skull from gunshot, followed by more or less perfect recovery, all of which occurred in the American War of Secession.

³ Mr. Hilton has pointed out the fact that in the middle of the basis cranii the brain by no means accurately fits to the bone, but, on the contrary, is separated from it by a considerable collection of cerebrospinal fluid; and he gives some interesting cases in which fracture of the base of the skull was proved to have taken place, but where at first there were no cerebral symptoms.—'Lectures on Rest and Pain,' edited by Jacobson, pp. 22-26.

of the brain. Such a classification, however, is far from complete ; for many cases are met with in practice which it is very difficult to include under the term concussion, and yet which do not exhibit any decisive evidence of compression. The only way to include all cases under these two heads is to regard all those as instances of concussion in which there is insensibility after injury (to a greater or less extent), unaccompanied by paralysis ; and all those in which there is paralysis, as cases of compression. But such a definition departs very far from the original meaning of the term concussion. In fact, when this term was introduced, it was believed that in cases where insensibility follows injury, without paralysis, the brain was often free from any visible lesion—very much in the condition of a jelly when shaken up—and that, if examined, no laceration of its substance or its vessels would be found. This opinion was supported by some histories of patients who had died immediately after blows on the head, whose death was attributed to concussion, and in whom the brain was found free from any trace of injury, as in the case recorded by Littré¹ of a prisoner whose arms were bound behind him, and who rushed with his head against the wall of his cell, falling dead on the floor. The brain alone was examined, and no trace of injury found in it ; and this case was put down as one of concussion without visible lesion of the brain. But, in this as in other cases of supposed death from concussion, the upper part of the spine was never examined, nor the viscera ; and Sir P. Hewett has pointed out that without such examination the fact that death was really caused by concussion is quite unproved ; in fact, it is most probable that in the case mentioned above the man died from injury to the upper part of the spinal cord. Sir P. Hewett gives a remarkable case where the death was attributed to concussion ; the head was alone examined, and the case would have been recorded as one analogous to Littré's, had it not occurred afterwards to another surgeon to reopen the examination and investigate the condition of the medulla oblongata and spinal cord, when death was found to be due to injury of the upper part of the spine. In other cases death may have been caused by rupture of the heart or some of the great viscera. There is, therefore, at present no evidence that any case of concussion ever occurs without anatomical lesion of the brain or its vessels to some extent. We may nevertheless concede that, as Mr. Savory argues,² even if it be true that no case of concussion occurs without some lesion, yet this does not prove absolutely that such lesion is the cause of the insensibility, since that insensibility will pass away suddenly, while the lesion must, of course, still be present ; and, besides, such lesions have been known to be present without any symptoms of concussion. Therefore, though it is not proved that concussion occurs without anatomical lesion, it is certainly not disproved—nay, there is *à priori* reason for thinking that it may do so.³

¹ 'Mém. de l'Acad. des Sc.' 1705, p. 54.

² 'St. Barth. Hosp. Reports,' vol. v. p. 72.

³ A case published in Mr. Hutchinson's 'Illustrations of Clinical Surgery,' p. 80, goes far to prove that even fatal concussion may occur without discoverable lesion. In this case the patient was a child æt. 5, and died 60 hours after the accident, in which she had been run over, the wheel apparently passing over the chest ; but the symptoms were mainly those of concussion, and no lesions were found in the lungs, heart, or spinal cord ; nor was anything found in the brain beyond general congestion. The same great authority expresses (ibid. p. 84) an opinion identical with that in the text : 'A considerable number of the head cases fatal within periods of a few hours or a day or two die from the general effects of the shake of the cerebral mass. Lesions are found, it is true ; but they are to be regarded as indications of the violence of the shake, and not as causes of death, nor perhaps even as serious complications.' Mr. Hutchinson regards anæmia of

It would be far more satisfactory, and more in accordance with the practice of surgical literature in its other departments, if we could classify the injuries of the brain, not according to their symptoms, as Concussion, Compression, &c., but according to the anatomical lesion, as cases of extravasation in the membranes or in the substance of the brain, of contusion, and of laceration of the cerebral substance. But our knowledge of the symptoms which depend on each of these injuries is so very imperfect that this anatomical division is as yet impossible. No distinct symptoms exist from which it can be affirmed that in one case there is extravasation of blood in the cavity of the arachnoid; in another, punctiform extravasation in the substance of the brain; in another, laceration of the surface; in another, of the central parts of the encephalon; and still less can we localise the lesion which we may suspect. All that can be said as yet is, that in cases of slight concussion small extravasations probably exist either on the surface of the brain or scattered about in its substance, or the brain is bruised here and there, and thus in all cases where the symptoms of head injury are very severe (as where there is severe spasm or profound coma, with general paralysis) the brain will be found lacerated. I exclude, of course, cases of external pressure, in which the compressing agent and the part compressed can be diagnosed with more or less approach to certainty.

Concus-
sion of the
brain.

The symptoms of concussion are those of surgical shock, with the additional brain symptoms. The patient is stunned, and lies insensible, with pale

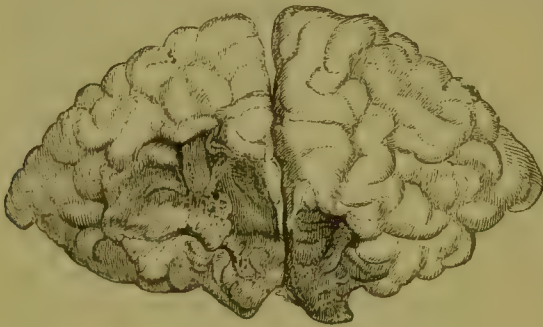


FIG. 46. Depression of the brain, from a case in which the patient had suffered from severe concussion twenty years before his death.

The case is related in Sir P. Hewett's essay, 'Syst. of Surg.' vol. i. p. 609, from which the woodcut is taken.

In this case the mechanical lesion which accompanied the symptoms of concussion must have been superficial laceration of the brain, followed by extravasation of blood into the lacerated part. In other cases punctiform extravasations have been found in various parts of the brain, and probably the extravasations of blood in the membranes of the brain uncomplicated with laceration or bruising of its substance, which are spoken of on p. 159, are sometimes accompanied by symptoms of concussion.

face and cold skin; the pulse is weak, possibly imperceptible, and often very irregular; the state of the pupils is variable, but usually they respond to light; the breathing is feeble and shallow; the urine and faeces may be passed involun-

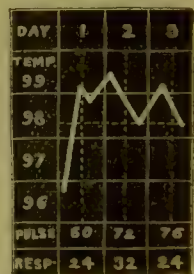


FIG. 47. Thermograph of Concussion.

tarily, but there is no paralysis of the sphincters, nor any other symptoms of paralysis.

This is the first stage, that of insensibility or collapse.

Tempera-
ture in
injuries of
the head.

I append a thermograph of an ordinary case of severe concussion which passed over in about the average time, and have also noted the rate of the pulse and respiration. (Fig. 47.)

The second stage is that of reaction. The patient can now be roused, though sometimes not without difficulty. He usually vomits. The pulse

the brain from spasm of the muscular coats of the arteries as being the proximate cause of the phenomena of concussion. Mons. Duret (referred to in 'Brit. Med. Jour.' Dec. 29, 1877) refers them to a change in the tension of the cerebrospinal fluid. But the question is certainly as yet unsettled.

risers and becomes more regular, and the natural temperature returns ; headache generally is complained of for some time, and drowsiness is a very common symptom.¹ After this the patient may entirely recover, or the third stage may ensue, which is that of traumatic inflammation of the brain or its membranes—to be afterwards described.

In some cases of severe concussion of the brain the stage of reaction, as above described, does not come on, as it usually does, in from ten minutes to half an hour, but the patient passes into a peculiar condition, which has been termed by Mr. Erichsen 'cerebral irritation.' The term does not, however, appear to be a very appropriate one, as 'irritation' would rather tend to imply that there is some inflammatory state present, and the great characteristic of the condition in question is the entire absence of any inflammatory condition whatever. The patient, instead of rallying from his concussion and recovering consciousness, lies curled up on his side, in a state of complete flexion. He is often restless, especially when disturbed, and may occasionally, when much irritated, toss himself about and even become violent and noisy. He will not answer questions, but may be induced, after much persuasion, to protrude his tongue. The skin is cold, and there is no heat of head. The temperature is generally subnormal. The pulse is weak and frequently very slow, sometimes not beating more than forty, or even less, in the minute. It is never, I believe, above normal. The eyelids are firmly closed, and the patient resists any attempt to open them, and usually turns his face from the light. If the pupils can be examined they will be found to be contracted, but responsive to light. The patient will take food, and will usually get out of bed to obey the calls of nature ; sometimes, however, the motions will be passed involuntarily and the urine be retained. These symptoms may, and usually do, continue for a considerable time, sometimes as long as three weeks ; the patient then begins slowly to recover consciousness, the pulse improves and increases in rapidity, the temperature becomes normal, and the patient no longer lies curled up in bed. Recovery ultimately, but slowly, takes place, and it will be found that while the patient has been in this condition the mind has been entirely absent, and the patient will not have the slightest recollection of anything since the accident until his complete recovery. Occasionally, instead of recovery, the patient passes into a more or less complete condition of fatuity. It would seem probable that in these cases there has been more or less contusion of the brain—that is to say, minute extravasations disseminated through the substance of the brain, or it may be extravasations on the surface, and that as this effused blood is gradually absorbed so the patient recovers consciousness. It is said that tonic spasm and restlessness are the two most characteristic symptoms of contused brain, and these are the two most marked symptoms of the condition above described. There is another form of contusion of the brain which requires mention, where a small circumscribed portion of the brain is infiltrated with blood, and this is often associated with laceration. The symptoms will depend on the particular part of the brain injured, and except the lesion implicate some particular motor area, or some part of the brain the function of which is with tolerable accuracy localised, it is difficult or almost impossible to come to a correct diagnosis. Occasionally brain contusion or laceration may be caused by *contre-coup*. A tolerably clear case of this came under my care a few years ago. A little boy was thrown from his

¹ I would refer the reader to the tabular statement of the usual symptoms of concussion given by Mr. Hutchinson on p. 86 of his 'Illustrations of Clinical Surgery.'

pony, striking his forehead, as was evidenced by a bruise in this situation. He suffered from a tolerably severe concussion, from which, however, he perfectly recovered, with the exception that sugar appeared in his urine and continued for about three years, when it gradually disappeared. The explanation seemed to be that the blow on the forehead had, by *contre-coup*, produced some bruising of the diabetic centre at the floor of the fourth ventricle, which accounted for the presence of the sugar in his urine.

Treatment.

No treatment is necessary in the early stage of concussion. If the collapse is very alarming it may be thought right to give some stimulant, but this is hardly ever necessary in cases of average severity. Warmth and sinapisms may be applied to the extremities and epigastrium. When reaction sets in, it should be watched. If moderate, nothing will be required beyond quiet, cold to the head, and low diet, with occasional purgatives. If the pulse rises very rapidly in volume and rate, it is right to take blood from the arm. But the question of venæsection and of the administration of mercury rather belongs to the treatment of traumatic inflammation, which will be considered further on.

It must be remembered that the tendency to death in pure concussion is from syncope or shock—failure of the heart's action; so that the only treatment which can be efficacious in the early stage is such an administration of stimulants as in the judgment of the surgeon will not involve the risk of provoking inflammation.

I would repeat that in this, as in all other forms of injury to the head, perfect quiet, in a darkened chamber, seems of great importance as a precaution against too severe reaction; and with regard to the importance of prolonged rest from mental and physical exertion, after all severe injuries of the head, I would refer to Mr. Hilton's admirable 'Lectures on Rest and Pain' (ed. 1877, p. 46 et sqq.)

Compression.

Compression of the brain is the term used to describe cases in which there is definite evidence of paralysis—a condition marked by stertorous, oppressed, and slow breathing; dilatation of the pupils, perhaps with insensibility to light; slow, laboured pulse; relaxation of the sphincters; coma; and paralysis of the limbs on one or both sides.

Compression of the brain may arise either from injury or disease. The traumatic causes, with which we have only at present to do, are extravasations of blood, depressed fracture, foreign bodies, and effusion of the products of inflammation.

The symptoms in a typical case are as follows: The patient is quite insensible, and from this insensibility he cannot be roused, and special sensation is destroyed. The breathing is slow, laboured, and stertorous, and is often accompanied by a peculiar blowing sound, with puffing out of the cheeks, from paralysis of the buccinator muscles. The surface of the body is generally hot, and covered with a profuse perspiration. The pulse is slow, laboured, and irregular. The pupils are generally dilated, or one may be dilated and the other undilated, and as a rule they do not respond to light. The bladder is paralysed, and if unrelieved by the surgeon overflows. The bowels are torpid, but the sphincter is relaxed, and they may act involuntarily. Nausea and vomiting are absent. There is always paralysis; which in traumatic cases is generally hemiplegia affecting the opposite side of the body to the injury. Where, however, the compressing cause is localised all these symptoms may not be present—in fact, they may most of them be absent.

Thus we may have a localised compression causing paralysis of one group of the muscles, or one limb, and the patient remain perfectly conscious and presenting none of the other symptoms enumerated above, but still the case is no less one of compression of the brain. Our knowledge of the topographical anatomy of the brain may enable us in some of these cases to localise the injury to a particular spot. And these cases will be considered later on in speaking of this subject. At present we shall confine our attention to those cases of general compression the symptoms of which have been detailed above.

Compression of the brain may arise from extravasation of blood, and this is by far the most frequent cause of this condition. It may be recognised by the fact that there is generally an interval of time between the accident and the occurrence of the symptoms of compression, especially in cases where the hæmorrhage has taken place between the membranes and the skull, which are the most important cases to the surgeon from an operative point of view. Here, the sequence of events is frequently as follows: The patient has an injury to the head and is picked up insensible, i.e. suffering from concussion of the brain; from this he rallies, and recovers, or partially recovers, consciousness, and then lapses into a state of unconsciousness again, with paralysis of the opposite side of the body; this is the unconsciousness of compression. Where the hæmorrhage occurs within the membranes or in the substance of the brain this sequence of events is not present, but even here, usually, there is an appreciable lapse of time after the injury before the symptoms of compression show themselves. Intra-cranial hæmorrhage may take place between the bone and dura mater, in the sub-dural space, on the surface of the brain, beneath the arachnoid, or in the substance of the brain itself.

When the extravasation is between the bone and the dura mater it depends either on laceration of the middle meningeal artery, of one of the large venous sinuses, and most probably the lateral sinus, or possibly of smaller vessels passing between the bone and dura mater. The anterior branch of the middle meningeal artery as it runs in a groove in the parietal bone is most commonly torn, the laceration generally being caused by a fissure running across the bone in this situation. When we have the symptoms above detailed of concussion followed by compression, or compression coming on after an interval of complete or incomplete consciousness and accompanied by hemiplegia,¹ the symptoms point to extravasation of blood between the bone and the dura mater. Mr. Jacobson states that frequently this interval is either absent or overlooked. It was so in about half the cases on which he bases a paper on this subject.² But it remains true that its presence is the only sure indication for treatment. The condition of the pupils is much relied on by Mr. Jacobson (following Mr.

¹ Hemiplegia is not by any means a constant symptom in compression from extravasation of blood. Mr. Hutchinson has given one striking example ('Illustrations of Clinical Surgery,' Pl. liv.), and referred to others in which it was absent. This seems to depend on the gradual occurrence of the bleeding. In cases also where the bleeding is very rapid, the hemiplegia, which doubtless is present, may be masked by the unconsciousness of the patient, and when present it is often very imperfect. So that the absence or incompleteness of hemiplegia is not a complete contra-indication for trephining in cases in which unconsciousness comes on after an interval, and where the patient seems likely to sink if unrelieved. The hemiplegia may be on the side which was struck; the opposite side of the head having probably been dashed against the ground or some other obstacle.

² 'Guy's Hosp. Reports,' vol. xliii.

Hutchinson) in these cases. It is alleged that a natural reaction of the pupils to light accompanies cases in which the brain is uninjured, and is probably in a recoverable condition, if trephining be at once performed, while if the pupils are insensitive and much dilated the operation is equally urgently called for, but the compression is extreme and the brain less likely to recover after removal of the clot. A widely dilated and insensitive pupil on the side of the injury, while the other is natural or contracted, is accepted as showing that the extravasation is passing into the base and making pressure on the third nerve, and is, therefore, a sign of evil import. The facts and observations cited in support of these conclusions are very interesting, and deserve most careful investigation; but, as Mr. Jacobson points out, the condition of the pupil can only be of value in conjunction with other symptoms.

Having arrived at the conclusion in a case of compression that the symptoms are due to effusion of blood between the bone and dura mater, the surgeon should at once proceed to investigate the region of the anterior inferior angle of the parietal bone on the opposite side to that on which the paralysis is noted. After shaving the scalp he should carefully search for any mark of an injury in this situation, and should endeavour to ascertain whether there is any history of a blow on this part. Even in the absence of this confirmatory evidence he is justified in cutting down and exposing the bone, commencing his incision about half an inch from the external angular process of the frontal bone and carrying it horizontally backwards along a line about an inch above the zygoma, or, according to Mr. Jacobson, at a somewhat higher level. Having exposed the bone he must carefully search for a fissure in it, and if this be found proceed at once to trephine. If no fracture is found the operation is not to be abandoned, if the other symptoms are fairly conclusive, for in some cases considerable hæmorrhage has existed without any fracture, from mere detachment of the dura mater; in others there has been fracture of the internal table only, and in others again the fracture has run through the posterior angle of the parietal bone, implicating the lateral sinus. The best plan, I think, is to prolong the incision backwards sufficiently to make sure that the case is not one of the last-mentioned class, and then to proceed with the operation as at first. After removing the crown of bone, if blood-clot is found, it must be carefully syringed away with some weak antiseptic solution, or removed with the scoop of a director. When the wounded artery is exposed it may cease to bleed, otherwise an attempt may be made to twist it, or the canal in the bone in which it lies may be plugged with a little bit of wood or wax. In some cases serious difficulty has been found in stopping the bleeding, so that it has been necessary to tie the common or external carotid or to use the actual cautery.

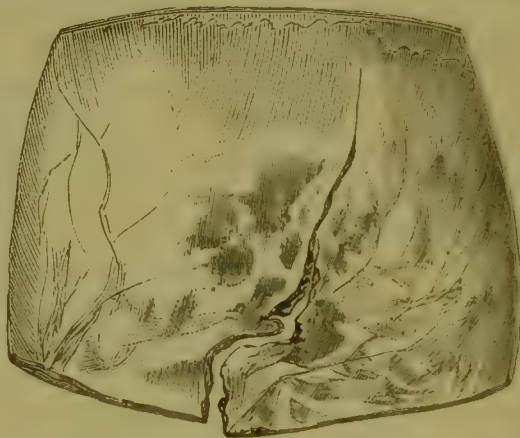


FIG. 48. The parietal bone of a child *æt.* 5, showing a gaping fissure which crosses the groove for the middle meningeal artery, producing considerable extravasation inside the skull (the traces of which are still visible), and still more hæmorrhage externally. The child was admitted a week after the accident with a large blood-swelling above the ear, but without any cerebral symptoms. On the fourth day after admission symptoms of meningitis commenced, and he died comatose four days afterwards. The subarachnoid cellular tissue was found infiltrated with purulent fluid.—St. George's Hospital Museum, Ser. i. No. 4.

Sometimes in some of these cases, where the fracture in the bone is widely open, the blood forces its way through the fissure into the tissues of the scalp, and there may be marked swelling in the temporal fossæ, and, as in the case from which fig. 48 was taken, no symptoms of compression.

Extravasation into the sub-dural space is a very common result of injury. It forms a layer of blood-clot which soon becomes decolourised and is ultimately replaced by a thin membrane, looking like a doubling of the arachnoid, or consisting in some cases of numerous layers. The layers may be continuous, forming a closed sac full of fluid, as in the case which furnished the illustration fig. 49.¹

Spontaneous extravasations of blood in this situation may also take place, and they possess exactly the same anatomical characters, and become organ-



FIG. 49. Drawing (half the size of life) of a cyst removed from the cavity of the arachnoid, which originated in hæmorrhagic effusion consequent on an injury received more than three years before. The drawing is from the 'Path. Trans.,' vol. vi. plate 2.—The preparation is in St. George's Hospital Museum, Ser. viii. No. 81.

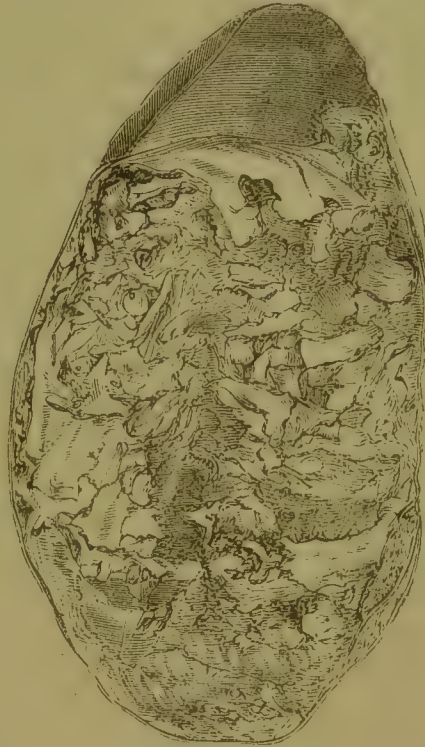


FIG. 50. The inner surface of the dura mater, showing a large quantity of blood extravasated and adhering to its arachnoid lining. This has become decolorised to a great extent, and begun to assume a membranous form. The dura mater itself and the longitudinal sinus are natural. There was some blood extravasated also on the external surface of the dura mater.

The preparation was removed from the body of a patient who had laboured for some days under symptoms of compression of the brain, the result of disease. The remains of the extravasated blood have been peeled off from the surface of the arachnoid at the upper part.—St. George's Hospital Museum, Ser. viii. No. 64.

ised in exactly the same way as the traumatic extravasations. Such was the case in the preparation from which fig. 50 was taken.

The symptoms of these extravasations are not clearly made out, nor does it seem at all certain that they produce any symptoms of their own, if the effused blood is not in large quantity. In some cases there have been anomalous symptoms of slight pressure or slight irritation of the convolutions, such as persistent pain, loss of mental power, alteration of temper,

Symptoms of traumatic extravasation into the sub-dural space.

¹ On the origin of these false membranes see a paper by Sir Prescott Hewett.—'Med.-Chir. Trans.' vol. xxviii. p. 45.

fits. When very thick, such effusions may cause more decided symptoms of compression, for which sometimes the trephine has been applied; the dura mater having bulged into the opening has been incised, and the blood having been evacuated, the patient has done well.¹

Symptoms
of traumatic ex-
travasation
in brain.
Diagnosis
of apo-
plexy.

When traumatic extravasations of blood, whether in the sub-dural space, in the meshes of the pia mater, or in the brain, are sufficiently large to produce symptoms of their own, these symptoms are so exactly like those of apoplexy that if the history is unknown or concealed, and there are no visible traces of injury, I am not aware that the diagnosis can be securely established.

It is, to say the least, excessively difficult in many cases to say, with any approach to certainty, whether it depends on injury or on disease, or on a mixture of the two, i.e. on slight injury acting upon tissues degenerated by disease. When the laceration involves the central parts of the brain, giving rise to rapid extravasation into the ventricles, the pons Varolii, or the medulla oblongata, the case rapidly proves fatal and is quite beyond the reach of surgical treatment. Extravasations of blood in the anterior part of the brain are far less fatal than in the middle or posterior lobes. The symptoms of compression come on far less rapidly and are often not so marked as when the lesion is situated more posteriorly. Injury of the motor area is followed by definite symptoms which can generally be easily recognised, and to which reference will be made hereafter.

Compres-
sion of the
brain from
depressed
fracture.

When the symptoms of compression have supervened immediately after the receipt of the injury, the cause is usually either a depressed fracture or the presence of a foreign body. The history of the case, and the examination of the wound, if there is one, will generally serve to differentiate between the two conditions; of course, if there is no wound, there can be no foreign body. Care must be taken, however, to make a thorough examination, for, as I have already pointed out, cases are recorded in which foreign bodies have been introduced, through the thin wall of the orbit, with the appearance of only a slight wound on the eyelid. It must be pointed out that the paralysis which accompanies depressed fracture or the lodgment of a foreign body often depends really on extravasation of blood within the brain from laceration.² In compression of the brain from depressed fracture, the rule in surgery is always to elevate, whether the fracture is simple or compound, but the operation is not followed by a large amount of success, first, on account of the reason just mentioned, that the compression is due not so much to the depressed bone as to some consequent laceration of the brain, and secondly, because in many instances the immediate object of the operation, viz., the replacement of the depressed bone, is not by any means perfectly effected. The examination of a large number of museum specimens has shown me that often, although the greater part of the bone has been lifted up, and the operation must have appeared to the surgeon to have been completed (and no blame can attach to him for thinking so, and for abstaining on that account from any further interference), yet examination from the inside would show spiculæ or depressed edges still irritating the membranes of the brain.

The case from which fig. 51 was taken illustrates one of the causes of

¹ Hewett, 'System of Surgery,' vol. i. p. 579, 3rd ed.

² Mr. Hutchinson says ('Illustr. of Clin. Surg.' i. 67) that he never witnessed a death produced by compression from depressed bone. There is also in his table of the causes of death in 46 fatal head-injuries only one of compression by extravasated blood.

failure above mentioned. Although the operation seems to have been performed most thoroughly and most successfully, it proved useless in consequence of the subjacent mischief.



FIG. 51. An extensive depressed fracture of the vertex of the skull which has been elevated by trephining. The mark of the trephine is seen at the corner of the sound bone, and it has also just touched the end of the depressed bone; and the traces of Hey's saw, which has been used to take off the overhanging edges of the sound bone, are very distinctly marked. The depressed bone has all been very fairly elevated, and the operation did temporarily relieve the symptoms of compression, as the patient became a little more sensible and was able to speak; but he only lived a few hours. Death was caused mainly, as it seems, by hæmorrhage between the bone and dura mater, the source of which was not precisely ascertained. The fracture passed across one of the main grooves for the middle meningeal artery, but the vessel itself appeared uninjured. The dura mater was not torn, but the lower part of the middle lobe of the brain was contused on each side. The depression seen at the back of this preparation appears to be due to some old injury; but nothing is known about it.—St. George's Hospital Museum, Ser. i. No. 16.

In contrast to this case is given an illustration of another (fig. 52) in which is seen one of the ordinary injuries in which the practice of different surgeons varies. There was no positive compression; the brain was deeply injured, and the surgeon thought it useless to interfere. Yet it is perfectly fair to argue that in a case where it would have been so easy to remove sharp edges of bone sticking into the wound of the membranes and irritating the lacerated surface of the brain, it ought to have been done, as affording a patient the last chance, however feeble

it might be: and such is unquestionably my own opinion.¹ The fracture is a less marked example of the form which Mr. Hutchinson figures on Pl. xxxii., under the name of 'pond depression,' and regards as extremely appropriate for trephining.

Little need be said on the subject of compression of the brain from a foreign body. In a large percentage of cases, the foreign body is a bullet, and these will again be referred to in gunshot injuries. These accidents are always of a very serious nature, and, as a rule, fatal; though foreign bodies may be lodged in the skull for a considerable time without causing death.

Compression from effusion of the products of inflammation will be referred to after the subject of traumatic inflammation of the brain and its membranes has been considered.

Inflammation of the brain and its membranes is the most formidable consequence of injuries of the head, and the chief object of our treatment is to obviate or combat it. It may affect either the membranes (meningitis) or the substance of the brain. The membranes may be involved in injury of the bone, the inflammation spreading from the dura mater inwards, leading to effusion in the arachnoid cavity, where it is almost always diffused, and to inflammatory cellulitis of the pia mater; or the inflammation may spread outwards from the injured brain, and then it is often limited to the pia mater. Inflammation of the brain-substance may be caused by the spread of meningitis inwards, or it may be the result of lesion of the substance of the brain, and so follow on a case which has commenced as one of 'simple concussion.' Its common results are, softening, usually of

Compression from foreign bodies, and effusion of the products of inflammation.

Traumatic encephalitis.

¹ Mr. Hutchinson teaches the same doctrine. See his Pl. xxix. and the commentary.

the surface, sometimes also of the central parts of the brain, effusion into the ventricles or abscess of the brain.

Inflammation of the brain and its membranes may be *acute* or *chronic*,

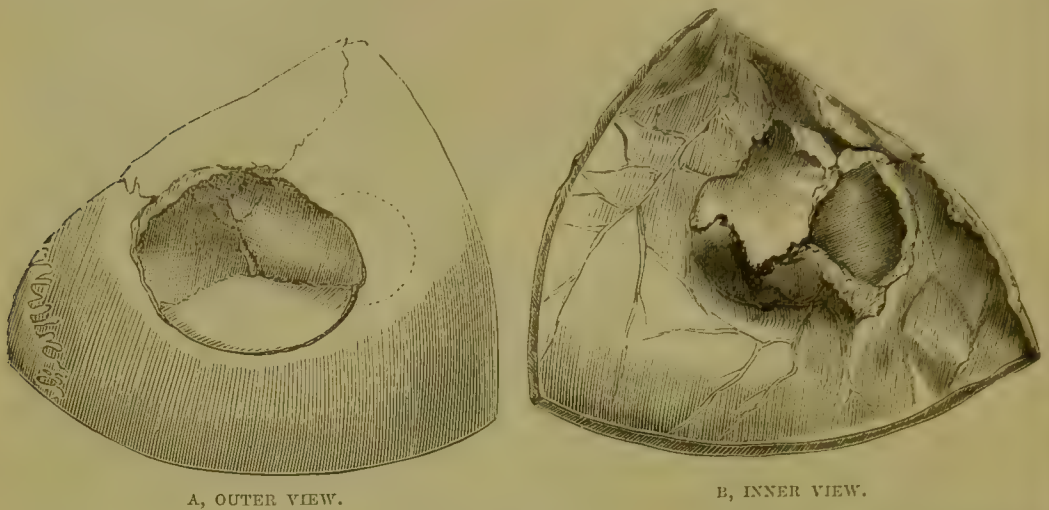


FIG. 52. Compound depressed fracture of the parietal bone. The brain in this case was lacerated, and the escape of brain-matter from the wound relieved the symptoms of compression, so that the patient (a boy æt. 16) was sufficiently sensible to give an account of the accident. He had no head symptoms for three days. Then pain in the head came on, with suppuration and increased discharge of brain-matter from the wound. A fortnight after the accident he became suddenly unconscious, with stertor and dilated pupils. Next day he died. At the post-mortem examination a large abscess was found, occupying all the outer part of the middle lobe on that side. The injury was caused by a fall through a skylight.

The drawing shows the exact limitation of the fracture, and the ease with which the whole of the depressed bone might have been removed. Fig. A presents the external aspect. At one angle is dotted the circle of an imaginary trephine hole. If this portion of bone had been removed, the whole fracture might have been elevated at once, for the large fragment at the opposite side of the fracture was perfectly loose (and has fallen out in the preparation), and by lifting up the upper of the two other fragments which were interlocked they might both have been most easily removed. Thus all the rough, jagged edges, which are seen in fig. B and which were sticking into the brain, would have been taken away.—St. George's Hospital Museum, Ser. i. No. 248.

and in their typical forms they are quite distinct from each other, though a series of gradations closely connect them together. It will be convenient however to describe them separately, but it is necessary to mention first that the symptoms of meningitis and inflammation of the brain-substance have not been found to admit of diagnosis from each other beyond such a conjectural opinion as is derived from the exciting cause, and moreover in most cases the two structures are more or less implicated at the same time. They will therefore be described together.

Acute inflammation of the brain and its membranes generally shows itself within twenty-four or forty-eight hours of the receipt of the injury. In fact, as soon as reaction sets in, the symptoms appear. The patient complains of severe pain in the head, with intolerance of light and singing noises in the ears, and with this there is a rapid rise in the temperature (fig. 53). The skin is hot, and especially the scalp, and the face flushed. The pupils are contracted. The pulse full, bounding and incompressible. Then sickness ensues, with restlessness and sleeplessness. Convulsions and convulsive twitchings, with delirium, usually of a noisy kind, supervene. These symptoms rapidly merge into those of compression. The delirium gives place to stupor, then



FIG. 53. A thermograph showing the rapid rise of temperature which sometimes is noted in cases of head-injury as inflammation comes on and passes into suppuration. The patient was admitted with compound fracture of the frontal sinus, involving also the internal table, a portion of which was driven into the brain. The depressed bone was perfectly loose, and was easily removed from the brain: but inflammation and suppuration of the injured anterior lobe rapidly supervened.

coma, with paralysis, and finally death. The first onset of inflammation may be heralded by rigors; but rigors occur usually in the later stage of inflammation, and may be taken as indicative of suppuration. The post-mortem appearances of such a case generally present morbid changes both in the membranes and the brain substance. In the former the arachnoid is the membrane which appears most to suffer; it will be found to be reddened and inflamed, and the surface of one or both hemispheres covered with a layer of greenish semi-purulent lymph,—chiefly deposited in the subarachnoid space, and extending far and wide of the original seat of injury, when the inflammation has been caused by some injury to the bone. The brain-substance will also be found, in most cases, to be involved. The ‘*punctæ vasculosæ*’ increased in number; the ventricles distended with blood-stained serum and the central parts of the brain (fornix, septum lucidum, &c.) softened, so that they can be easily broken down. Whenever traumatic inflammation is diagnosed, or even when there is reasonable cause for apprehending such an event, the first indication is certainly to shave the head and apply cold to it, to purge the patient very freely by a large dose of calomel, followed by a saline purgative, and to keep him very quiet in a darkened room. Rigid abstinence must be enjoined. If the patient is a healthy, young subject, and the pulse rises decidedly in rate, and its volume and hardness increase, there can be no question that venesection is often followed by marked benefit. It must only be resorted to, however, at the onset of the symptoms, and the patient should be bled to faintness, so as to produce a decided effect. At the same time mercury should be given in powder, calomel being the drug usually selected, in doses of about 2 grains four or six times a day. The powder can be placed on the back of the patient’s tongue with a little sugar, or mixed with butter, if he is unable or unwilling to swallow. When coma, indicating compression of the brain, comes on, it is clear that these cases are beyond the reach of surgical operation.

Chronic inflammation of the brain and its membranes is most frequently the result of injury to the bone, spreading inwards to the dura mater, and then involving the other membranes and the brain substance. These cases are frequently followed by the formation of a localised abscess, sometimes between the bone and dura mater (to which allusion has already been made), sometimes in the arachnoid, and sometimes in the brain-substance itself.

The symptoms as a rule do not show themselves for some time, it may be for weeks, after the injury, and are then of a most insidious and vague character. Constant pain in the head, with sleeplessness and restlessness, followed perhaps by impairment of the senses, irritability of the brain, and local paralysis are among the most prominent symptoms. When these symptoms are accompanied by a well-marked rigor, and especially if symptoms of pressure on one or more of the motor areas are present, the presence of a cerebral abscess is fairly indicated, and the question of trephining for its relief will have to be considered. The medicinal treatment of these cases is most unsatisfactory. The patient is unable to bear any active measures, nor indeed is such treatment necessary. Counter-irritation, in the form of blisters to the nape of the neck constantly repeated, and mercury administered internally until the gums are slightly affected, appears to yield the best results. When there is evidence that suppuration has taken place, the question of operative interference will have to be considered. It is obvious that some of these cases are incurable, but that others are at all events capable of being cured, and justify the surgeon in resorting to trephining,

though at the same time the cases of recovery after trephining for pus in this country are very few indeed within living memory. The cases which are, of course, most likely to succeed are those where there is a localised abscess between the bone and dura mater, evidenced by the presence of Pott's puffy tumour (see p. 146), a condition so rare that many surgeons of large experience have never seen it. Abscesses in the arachnoid cavity have been found limited and have been successfully opened,¹ and even abscesses in the brain-substance itself.² The indications which should guide the surgeon as to the situation of the abscess will be referred to in the sequel.

Hernia
cerebri.

Hernia cerebri is a consequence of local or limited inflammation of a portion of the brain, co-existing with wound or sloughing of exposed dura mater, whereby the inflamed brain is forced through the skull. It is not every wound of the brain, even when it involves loss of substance, which necessarily produces hernia cerebri. There are plenty of instances on record in which large portions of the brain have been torn away in injuries of the head, and the wound has healed kindly. But very commonly after a compound fracture, in which the dura mater has also been lacerated, in a few days an offensive ichorous discharge is noticed from the wound, and a fungous mass begins to sprout out of it. This sloughs and drops off in fragments, which, if examined by the microscope, are found to consist in great part of the products of inflammation. Sometimes indeed they consist entirely of such products, and to these protrusions the name of 'false hernia cerebri' is sometimes given, reserving the name of 'true' for those in which the characteristic structure of the cerebral substance can be found.

Hernia cerebri is generally fatal, though by no means universally so. It commonly occurs in compound fractures of the vertex; but I have figured above an instance in which it took place in the middle fossa of the base of the skull (fig. 41), and Mr. Holden has referred to a remarkable instance in the anterior fossa, where the patient, a boy, lost a large quantity of brain-matter through the nose, but ultimately recovered. The protrusion is a mushroom-shaped mass, of a dark red colour, which increases somewhat rapidly and pulsates synchronously with the brain.

The treatment of hernia cerebri usually consists in removing all sources of irritation, washing away the products of inflammation by gentle syringing, and applying antiseptic compresses. Dr. Maclaren has lately published a case³ in which benefit seemed to be produced by inserting a plate of silver inside the hole in the skull so as to oppose further protrusion, while leaving an interval for drainage. In that case the herniated portion was removed from time to time, to allow of the application and reapplication of the silver plate.

Cephal-
hydrocele.

In connection with hernia cerebri must be mentioned a condition somewhat resembling it, which has been described by Professor Conner of Ohio,⁴ in which a tumour filled with serous fluid, possibly cerebro-spinal, forms at the site of a fracture in the skull. To this he has given the name of cephal-hydrocele. He has found it only in children, and he states that, if protected,

¹ Dumville, 'Brit. Med. Journ.' 1858, vol. ii. p. 743. Roux, 'Archives Générales,' vol. xxiv. p. 268.

² The latest published cases which I have met with are Mr. Holden's ('St. Barth. Hosp. Reps.' vol. ix.), and Mr. Hulke's ('Med.-Chir. Trans.' vol. lxii.). Others will be found referred to in the article on 'Injuries of the Head,' 'System of Surgery,' vol. i. 3rd ed.

³ 'Clin. Soc. Trans.' vol. xix. p. 159.

⁴ 'Amer. Journ. Med. Sci.' July, 1884. See also 'St. Barth. Hosp. Reps.' vol. xx.

it does not increase in size, and apparently causes no harm to the child, but that any surgical interference is generally attended with serious results.

I can say but little on the subject of direct lesion of the nerves at the base of the brain. Those of the seventh pair are the most common, and in

Injuries of
the cranial
nerves.

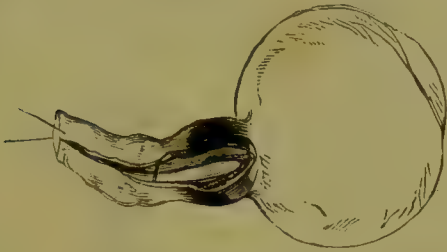


FIG. 54. Extravasation of blood in the sheath of the optic nerve after injury to the head. From Mr. Hewett's essay, 'Syst. of Surg.' 3rd ed. vol. i. p. 615.

fractures of the base loss of hearing and facial paralysis are not unfrequently noticed. Extravasation of blood in the sheath of the optic nerve has been found after death, and blindness may be so caused, and may pass away, though in other cases it has resulted from absolute laceration of the nerve, and is then probably permanent. But all the nerves of the base (with the exception, I believe, of the little fourth nerve) have presented distinct evidence of traumatic lesion, as indicated by the loss of their function, and proved by post-mortem examination. No treatment can be adopted; but the symptom is often valuable in a diagnostic point of view. It is important to remember the fact on which Mr. Le Gros Clark has laid some stress, that the symptoms of paralysis, indicating lesion of the nerves at the base of the skull, often do not present themselves till three or four days after the receipt of the injury, showing that they are due to inflammatory reaction. This fact, however, by no means negatives the diagnosis of fracture, since a fracture is one of the most probable causes of such inflammation.

The operation of trephining the skull, although it is always called by that name, is not always performed with the circular saw called the trephine.

Trephining
the skull.

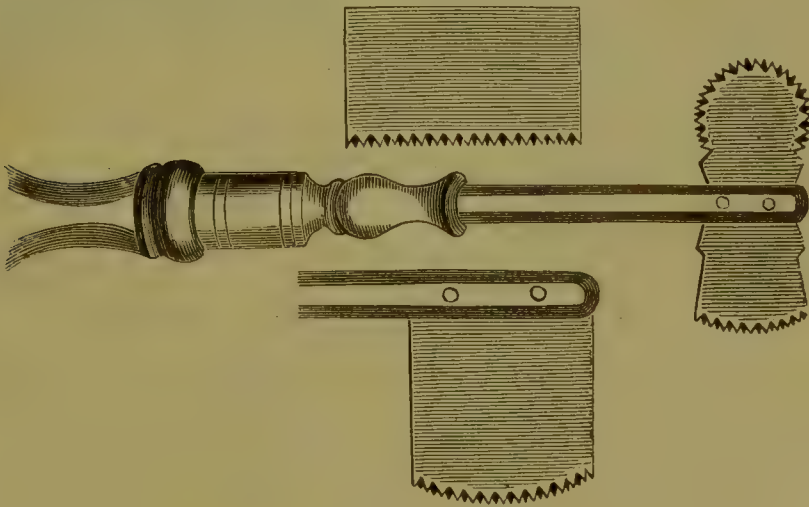


FIG. 55. Hey's Saw (from Hey's 'Surgery').

The elevated edge of an injured bone is often more easily and expeditiously removed by the saw which bears Hey's name.¹ The straight edge enables the surgeon to remove any length of bone at one stroke. When a curvilinear direction has to be given to the section the round edge must be used.

Trephining is an operation which is neither very easy in all cases, nor

¹ This saw, as Mr. Hey points out, was originally figured in Scultetus's 'Armamentarium Chirurgicum,' and was either revived or re-invented by Dr. Corbell of Pontefract, who showed it to Mr. Hey.

destitute of dangers of its own in any. The soft parts are first to be cleaned carefully from the part of the bone on which the trephine is to be applied, which in cases of fracture should be the sound bone on the edge of the depressed portion, and, if there are two depressed and interlocking pieces, the trephine-hole should hit the edge between them (see fig. 52). It is well to avoid the known situation of a large sinus if possible, though in cases of depressed fracture it may be necessary to apply the trephine directly over a sinus (see fig. 51). The pin of the trephine, being run out and firmly fixed, is applied at such a point as will secure this object,



FIG. 56. The 'Elevator.' *Mem.* In trephining it is well to have a few elevators of different shapes and curves at hand. The one here represented is, however, one of the most useful.

and then by a screwing motion the section of the bone is commenced. When the groove is deep enough to avoid all risk of the trephine slipping, its pin is withdrawn, and as soon as the surgeon believes that he has got through the external table¹ he begins to proceed with caution, and with a very light hand, often feeling the groove with a fine probe, or, as is more usual, a common quill toothpick. When the internal table is perforated at any part of the circle the elevator is introduced here, and the crown of bone will generally come away. If it does not do so, the internal table must be sawn in some other part; but the trephine must not be pressed on the part already sawn through, for fear of wounding the dura mater. When the first crown of trephine has been removed it may be necessary to take away a second or a third, or to saw off the projecting edges of the sound bone with Hey's saw (as in fig. 51); or perhaps the whole operation may be accomplished with the saw, in using which the same precautions are to be taken as in sawing with the trephine; but there is less risk of wounding the dura mater with Hey's saw, since it is only applied on the sound edge close to the fracture, and here the dura mater has of course been driven down by the depression. The greatest danger to the dura mater is in cases like the one from which figure 58 was taken, where the skull is of different thicknesses at different parts of the circle.

As will be seen from the foregoing pages, trephining is indicated—1, in cases of compression produced by depressed fracture or lodged foreign bodies;

¹ Sometimes the removal of a crown of trephine from the external table only will allow the surgeon access to the depressed bone so as to remove it—a fact of which Mr. Hutchinson gives two examples (op. cit. Pl. XXXI. figs. 1 and 3).



FIG. 57. Trephine. The central pin is seen projecting slightly beyond the teeth of the saw. It can be withdrawn altogether within the crown of the instrument by the screw which is seen in the cleft of the stalk.



FIG. 58. The vertex of the skull, with a portion of bone removed in trephining for supposed depression of the inner table, ten months after the injury. The skull had been much thickened, especially at its back part, by inflammation, so that the thickness of the bone removed is twice as great behind as in front. In consequence of this irregularity in thickness the dura mater was wounded in the operation.—St. George's Hospital Museum, Ser. ii. No. 24.

2, in certain cases of irritation or symptoms of pressure supervening in depressed fracture; 3, in cases of localised pressure from extravasated blood; 4, in cases of intracranial suppuration where the symptoms are those of localised pressure.¹

In some of these cases, as in compression from a depressed fracture, there is no difficulty, of course, in determining the position in which to apply the trephine; whereas in others, as in those of intra-cranial suppuration, we must be guided as to the situation of the matter, and therefore the position in which to apply the trephine, by the symptoms which the patient presents; and this leads me to say a word or two on the theory of the localisation of function. For of late years physiological and pathological research have rendered it no longer doubtful that there are certain areas in the brain which are intimately connected with certain peripheral nerves, and that lesion of these areas produces signs of irritation or pressure in the corresponding peripheral region. And these investigations have gone far to prove that the surface of the brain may be mapped out into a series of topographical areas, each of which is intimately connected with some well-defined function, though whether they are the originators of the impulses is still uncertain. Our knowledge of this subject is still very imperfect, obtained as it has been by experiments on the higher mammals, though controlled to a great extent by pathological observation, but is every day becoming more and more exact.

But in one point most physiologists are, I think, agreed, and that is that the convolutions on either side of the fissure of Rolando are concerned in motion, and that there are definite areas in these convolutions, which are connected, in a manner not quite understood, with definite groups of voluntary muscles. This has been proved both experimentally and by clinical observation. In the former manner, it has been shown that by stimulating certain areas with a weak Faradic current, movements are produced in a corresponding group of muscles, and destruction of the same areas produces paralysis of the same group of muscles which were stimulated by the Faradic current. There is still, however, considerable difference of opinion as to the exact spot in these areas in which special motor-functions are to be placed. The following facts are, I think, sufficiently well established. The movements of the *upper* limb are connected with an area partly in front and partly behind the fissure of Rolando at its upper part. The portion behind the fissure, in the ascending parietal convolution (fig. 59, 1.), is concerned in the movements of the fingers, hand, and wrist. The area at the upper end of the fissure, comprising the upper part of the ascending frontal convolution, the hinder part of the superior frontal convolution, and a small portion of the ascending parietal (fig. 59, 2.), is concerned in the co-ordinated movements of the upper and lower limbs together in various complex movements, as in swimming, climbing, &c. The portion below this area, in the ascending convolution (fig. 59, 3.), is concerned in the movements of the forearm, especially in those of supination and flexion in which the biceps is particularly engaged, whilst the area above and in front of this, at the posterior part of the superior and middle frontal convolutions (fig. 59, 4.), is associated with a forward movement of the hand and arm, as in putting out the hand to touch something in front.

The movements of the lower limb are connected with an area situated

¹ Trephining has also been employed in a few cases of cerebral tumour. These will be referred to when speaking of Diseases of the Head.

behind the upper part of the fissure of Rolando, comprising the upper part of the ascending parietal and the adjacent part of the superior parietal convolution (fig. 59, 5.).

The movements of the face are connected with an area principally situated in front of the lower part of the fissure of Rolando, but also to a certain extent behind it, and comprising the lower part of the ascending frontal convolution, with some of the inferior frontal convolutions, and the adjoining portion of the ascending parietal on the other side of the fissure (fig. 59, 6, 7, 8, 9). That area in front of the fissure being associated with elevation and depression of the angles of the mouth, whilst that behind the fissure marks the centre for movements of the lips and tongue.

The centre of *speech* is, however, perhaps the best localised of all the functions. This is universally placed in the posterior part of the third or inferior frontal convolution on the left side. This was first demonstrated by Broca from pathological observation, by shewing that disease in this region



FIG. 59. Diagram to show the position of the motor areas and their relation to the surface of the skull. 1. Area for movements of fingers, hands and wrists. 2. Co-ordinated movements of upper and lower limb. 3. Movements of supination and flexion of upper limb. 4. Forward movement of hand and arm. 5. Area for movements of lower limb. 6 and 7. Centres for movements of the elevators and depressors of the angle of the mouth respectively. 8 and 9 mark the centres for movements of the lips and tongue, as in speech. Speech especially occupies the anterior part of 8 on the left side. F.R. Fissure of Rolando. F.S. Fissure of Sylvius.

produces aphasia, and was the first attempt at the localisation of function. This portion of the cortex of the cerebrum is generally known as Broca's convolution.¹

¹ The summary which has been above given of the areas connected with motor functions has been principally derived from the experimental researches of Ferrier. They differ somewhat from the views of other authorities, and must not be looked upon as a final statement of fact, until they have been confirmed by clinical and pathological observation. For purposes of comparison I have placed here the views of two other authorities, as given by Mr. Treves in his 'Surgical Applied Anatomy': 'According to Charcot, the centre for movements of the tongue is situated at the posterior end of the third frontal convolution and contiguous part of the ascending frontal convolution; movements of lower part of face at the lower end of the two ascending convolutions; centre for forearm and hand on the middle third of the ascending frontal convolution; centre for movements of the lower limb on the upper third of the ascending frontal convolution and upper two-thirds of the ascending parietal convolution. According to Hitzig, the motor centre for upper limb is at upper part of ascending frontal convolution; motor centre for lower limb

With these data to go upon we possess means by which we can form an opinion as to the region of the brain affected from reliable indirect information, where direct evidence as to the seat of an injury is not obtainable. If for instance a patient, who has sustained an injury to the head, presents signs either at once or subsequently of paralysis of a distinct group of muscles—say, for instance, those of a limb—we arrive at the conclusion that the brain lesion is situated in that area of the cerebral cortex which is associated with this particular group of muscles on the opposite side of the body. Or on the other hand, if immediately after an accident there is a distinct spasm affecting a limb, we conclude that the corresponding area on the opposite side of the body has been lacerated and is irritated, but its function not entirely destroyed. And if this is followed after a time by paralysis of the same group of muscles; and further, if the paralysis extends to other parts of the same side, we gather that blood is being poured out and is gradually extending over the hemisphere. It will be seen therefore that when the question of trephining arises in certain cases of compression of the brain, we have indications by which to determine the site at which to perform the operation. To be of practical use to the surgeon, however, it is necessary to define some rule by which these various convolutions may be mapped out on the surface of the head. It will be seen that the keystone to doing this is to exactly define the position of the fissures of Rolando and Sylvius, and then the various centres referred to above, with perhaps the exception of Broca's convolution, can be fairly accurately mapped out. Various rules are given for demonstrating the line of the fissure of Rolando. Perhaps the simplest plan, and one which is sufficiently accurate for all practical purposes for finding the upper end of the fissure, is the one recommended by Professor Thane, though it is subjected to slight variations according to the size of the head. He divides the distance from the glabella at the root of the nose to the external occipital protuberance into two equal parts, and having thus defined the middle point of the vertex, he takes half an inch behind it as the top of the fissure. From this point the fissure runs downwards and forwards, its axis making an angle of 67° with the middle line, for $3\frac{3}{4}$ inches. Professor Thane places the 'lower end close to the posterior limb and about an inch behind the bifurcation of the fissure of Sylvius.'

In order to define the fissure of Sylvius a line is drawn from the external angular process of the frontal bone backwards to the occipital protuberance. An inch and an eighth along this line backwards from the external angular process marks the commencement of the fissure of Sylvius. From this point a line drawn to the parietal eminence denotes the course of the posterior limb of the fissure. The bifurcation of the fissure corresponds, according to Thane, to a point one inch and a quarter behind, and a quarter of an inch above, the level of the external angular process of the frontal bone. The ascending limb of the fissure passes upwards from this point parallel to, and immediately behind, the coronal suture.

In order to find Broca's convolution, a horizontal line is drawn backwards from the external angular process for two inches, and a vertical line drawn upwards from the extremity of this for three-quarters of an inch. The upper extremity of this line marks the position of the posterior part of the inferior frontal convolution.

on ascending frontal convolution, just below preceding centre; motor centre for facial muscles at middle part of ascending frontal convolution; centre for muscles of mouth, tongue, and jaws at inferior part of ascending frontal convolution.

CHAPTER VIII.

INJURIES OF THE BACK.

Sprains of
the back.

SPRAINS of the back are amongst the commonest of all accidents. They are the effect of wrenches or contusions, either of which produce violent flexion of the whole column, and which, therefore, sprain it at the part where flexion is most free.

The injury consists in stretching, and in the severer cases probably more or less rupture of the muscles, fasciæ, and ligaments on the posterior aspect of the spine, while the parts in front may be more or less crushed; and in particular the kidney is sometimes contused or lacerated. The latter injury will, however, be treated of by itself in a subsequent section. When there are symptoms of injury to the spinal cord itself ('concussion of the spine,' as it is termed), those symptoms constitute the main feature of the case, and will be spoken of presently. In this place I shall speak merely of the uncomplicated sprains.

Symptoms.

There is swelling at the injured part, with subsequent inflammation; but generally no visible ecchymosis, since the blood which must have been poured out is beneath the deep aponeurosis. There is great pain in moving, and especially in extending the spine. The prognosis is very favourable, though recovery is often slow. Sometimes, however, disease of the bones or joints of the vertebral column, or low inflammation of the cord, or disease of the kidneys follows on what was apparently a simple sprain; and in some of these cases unsuspected fractures or dislocations have been found. I would refer for some interesting examples of these complications to Mr. Jacobson's essay on *Injuries of the Back* in the 3rd edition of the '*System of Surgery*.'

Treatment.

If, from the severity of the injury, the patient is at all collapsed, the first indication is to revive him from that condition. Then, at first, moderate general and local antiphlogistics will be indicated, with opiates, mercurial purges, Dover's powder at night, salines, spoon-diet, and leeches. Afterwards fomentation with poppy-heads, warm Goulard lotion, with laudanum, or compresses of tincture of arnica (3j. to Oj.). When the patient is able to move in bed and sit up, friction and stimulating embrocations (liniment. Iodi, Terebinthinæ, Sinapis), or blistering or painting with iodine, will probably relieve any remaining pain. In obstinate cases an occasional light touch with the actual cautery is very beneficial.

Fracture
or disloca-
tion of the
spine.

Fracture or dislocation of the spine is one of the most fatal of all accidents. Fracture sometimes affects only some of the processes of the vertebræ—most commonly the spinous—and the mobility of the fractured process is the only symptom necessarily connected with the injury. No treatment is required beyond rest and a bandage. But when 'fracture of the spine' is spoken of, it is understood that the continuity of the whole vertebral column is severed. The gravity of the injury does not, however, depend on the fracture itself; for although no doubt the spinal column is the centre for almost all the movements of the body, and its integrity is, therefore, necessary for any active

motion, yet this integrity would be restored after fracture, by bony union,¹ as in any other bone, and the solidity of the column would probably not be materially impaired. Fig. 60 is an example of the repair of a fracture of the spine by bony union in a patient who happened to survive long enough for the completion of the process. But the history of the same preparation also illustrates the reason why this injury is so fatal, for the cord in that case was crushed by the fracture, as it almost always is; so that, although the bones united, the spinal symptoms were unrelieved, and pursued their usual course to a fatal termination.

In describing, therefore, the symptoms of fracture (or dislocation) of the spine, I must premise that most of these symptoms are what are called (on p. 123) merely the *rational* symptoms of fracture, i.e. lesions for which we can find no other cause; and that some cases occur in which similar symptoms (or symptoms very nearly similar) appear to be produced by contusion of the cord without fracture; while, on the other hand, there are cases on record in which fracture of the spine has been proved by post-mortem examination to have occurred, yet in which there have been no such symptoms, in consequence of the cord having escaped injury.



FIG. 60. Fracture of the spine united, the patient having survived five months. The body of the last dorsal vertebra is crushed; some of its fragments are driven forwards, forming an irregular ring of bone which lies in front of the body of the first lumbar, to which it is soldered by bony union. Another large fragment is driven backwards into the canal. The solidity of the column is restored, but with slight angular curvature.—From a specimen in St. George's Hospital Museum, Ser. i. No. 49.

The symptoms, then, of fracture of the spine are as follows: pain in the part, aggravated by passive motion, more or less incapability of moving the spine at that part, and deformity of the spinal column. All these are no doubt direct symptoms of the injury; but they are not decisive, with the exception of the last, which, if present in a marked degree, leaves no doubt; but it is frequently absent. There is usually considerable collapse from the severity of the injury. The usual sequelæ, and those by which we infer the existence of fracture, are complete paralysis of motion and sensation in all the parts supplied with nerves from below the seat of the lesion.

In some cases there is hyperæsthesia just above the parts in which sensation is lost, depending either on irritation of the nerves as they quit the intervertebral foramina, or of the cord above the disintegrated part.² In fracture above the origins of the phrenic nerve (i.e. above the fourth cervical vertebra), that nerve, as well as all the others which supply the respiratory muscles, will probably be paralysed, and death will be instantaneous.³ With fracture lower down in the neck, the patient will retain the

¹ The occurrence of bony union is denied by Sir C. Bell, and Rokitsansky says it is rare—but I believe this is only because recovery is rare.

² Hilton's 'Lectures, edited by Jacobson,' p. 64.

³ A very interesting case is related by Mr. Shaw, in the 'Syst. of Surg.' 3rd ed. vol. i. p. 684, in which a fracture with displacement of the first and second vertebrae was accompanied by no serious symptoms, the fragments being displaced forwards, towards the pharynx, instead of backwards on to the cord. The patient died from dropsy a year afterwards, and the preparation is in the Museum of the Middlesex Hospital. The same author (ibid. p. 665) relates a case in which the patient survived fifteen months after a fracture of the fourth or fifth cervical vertebra, though the cord was entirely disorganised at the seat of fracture, and there was therefore paralysis of all the parts below the head.

power of diaphragmatic breathing, but not the motion of the intercostals or of any other muscle of respiration, or of any of the muscles of the trunk or limbs. Sensation will also be completely absent in all parts below the neck, except that in some cases perception of impressions may still be noted in the parts supplied by the superficial descending branches of the plexus; the sphincters are paralysed, so that the urine is at first entirely retained, and then dribbles over, and there is no power of retaining the fæces; the passage of the catheter, though unfelt, usually excites priapism.¹ The reflexes are often altered, the alteration varying according to the seat of the lesion, and thus becoming important indices as to its situation. The reflexes corresponding to the portion of cord crushed are completely lost, thus a fracture of the dorsi-lumbar spine may be attended with entire absence of knee-jerk; but the reflexes corresponding with portions of the spinal cord in the neighbourhood of the crush are, in the course of a few days, when myelitis sets in, frequently much exaggerated, then tickling or pinching the limbs will very often produce violent spasmodic movements. The intellect is unaffected, and the patient usually free from pain. The temperature of the paralysed part varies. Sometimes it is higher than that of the body; but this is not always the case.²

In fractures so high up as this the patient usually dies in two or three days, and often much sooner. Death is produced generally by the accumulation of fluid in the lungs, which the patient is unable to cough up, and which chokes him. But when death follows more rapidly it is probably from hæmorrhage into the substance of the cord or into its theca, which produces pressure on or disintegration of the spinal marrow above the seat of fracture.

The lower down in the column the fracture is situated, the less is the extent of the paralysis. At the lower part of the lumbar region, where there is no spinal cord, but only the leash of nerves of the cauda equina, some of these nerves may escape injury while the rest are torn, and so the resulting paralysis of the lower limbs may be imperfect. Usually, however, in fractures of the lumbar spine the lower limbs and the sphincters are totally paralysed. In the dorsal region there is also paralysis of the abdominal muscles and loss of sensation to an extent corresponding to the seat of the injury, while in fracture of the upper part of the dorsal spine symptoms of

A case is recorded by Dr. May, of Middletown, Conn., in the 'American Journal of Med. Sci.' Oct. 1876, in which the fracture, besides implicating the upper vertebræ, traversed the base of the skull also—and where the fragments were sufficiently displaced to encroach considerably on the foramen magnum, yet the patient recovered. In this paper references will be found to the other cases in point. Another very interesting case where the patient was under observation from the time of the accident to his death ten years afterwards is related by Dr. Lowson, 'Med.-Chir. Trans.' vol. lxxviii. p. 135.

¹ 'Priapism will be absent in fractures of the lumbar region where the reflex centre has been crushed, or in severe injuries of the cauda equina, damaging the nerves in which run both the sensory irritation and the inhibiting influence between the lumbar centre and the periphery. Priapism is most common after crushes of the cervical and upper dorsal cord; it is never met with after injuries to the lower lumbar cord.' Jacobson, *op. cit.* p. 649.

² On the temperature after injuries to the cervical portion of the cord see Wunderlich's 'Manual of Medical Thermometry,' translated by Dr. Woodman for the New Syd. Soc. p. 423. If we can trust the observations there recorded, the temperature has been found as high as 111° F. and as low as 86°. In 'Clin. Soc. Trans.' vol. vi. p. 75, may be found a case of laceration of the cord opposite the first dorsal vertebra, where the temperature in the axilla is said to have fallen as low as 80·6° F. See also Mr. Jacobson's essay in the 'Syst. of Surg.' p. 653.

difficulty of breathing occur which approach more and more to those produced by fracture in the cervical region.

The later symptoms of fracture of the spine are due to low inflammation of the urinary mucous membrane, and to sloughing of the skin. The urine which dribbles over, or which is withdrawn from the bladder, is at first natural; but it soon becomes very offensive, phosphatic and alkaline. For a while it may be secreted acid, and only becomes alkaline from decomposition in the bladder, but after a time it is secreted alkaline in the kidney, the inflammation having extended to that organ. This inflammation is partly due no doubt to the retention of the urine in the bladder, but not entirely so; nor can it be entirely obviated by withdrawing the urine frequently and washing out the bladder with acidulated lotion, although these measures will diminish it. In fact, there is a tendency to low inflammation of all the mucous membranes as well as of the skin, as a consequence of the deprivation of their nervous influence. This may lead, according to some, to certain 'trophic' lesions in some part of the urinary tract resulting in sloughing inflammation, and the products of this may lead to the changes which are noticed in the urine. The presence of micro-organisms, which are invariably found in these cases in the urine, appears to give additional support to this hypothesis. Some authors have endeavoured to account for these organisms, by asserting that they were due to the introduction of septic matter by means of the catheter, but they have been found in cases where no instrumentation has been resorted to. This deprivation of nervous influence is shown sometimes in the intestines by the tarry condition of the fæces, and the congestion found after death; and probably the low bronchitis which is so constant in fractures high up is not caused by hypostatic congestion alone. So also the gangrene of the skin, though greatly accelerated by pressure, is not due entirely to that cause, as will be stated below.

Apart, then, from complications, the tendency to death in fractures high up is from the pulmonary congestion; in those low down from urinary inflammation or from sloughing.

The symptoms of dislocation are the same as those of fracture at the same level, and the cause of death is the same. Thus in the specimen from which fig. 61 was taken, and which is one of pure dislocation at the level at which this injury is most common (i.e. at the root of the neck), the upper vertebra was thrown forward, and the lower backward, and the cord crushed between them. Death took place at the usual period, viz. two days after the accident. And some amount of dislocation is a usual concomitant of fracture, so that the two are always treated of as being practically the same injury.¹ There is, however, one point of practical importance in connexion with the subject, viz. the possibility of diagnosing and reducing dislocation, and the prospect of benefit from such reduction. Most dislocations occur at the lower part of the cervical region, though a few examples are recorded in the dorsal;² and I have published an instance of one (of which the preparation is in the Museum of St. George's Hospital) between the last dorsal and first

Dislocation of the spine.

Reduction of dislocation.

¹ In Mr. Le Gros Clark's 'Lectures on the Principles of Surgical Diagnosis,' p. 142, will be found the account and drawing of a case in which, along with fracture of the spine, the fifth lumbar vertebra was dislocated from all its connexions, and thrown entirely behind the spinal column.

² In all the dislocations, however, below the cervical region which have hitherto been recorded, there has been some fracture of the processes of the vertebrae.

lumbar vertebra in which the dislocation was actually reduced.¹ But the reduction had no effect in relieving the symptoms of paralysis, and it is even possible that the force employed may have been the cause of suppuration which took place around the seat of injury, and which proved the starting-point of general pyæmia. Nor do I see by what signs it is possible to recognise the existence of dislocation apart from fracture.² Yet, though the diagnosis may be uncertain, and though it is certainly possible that harm may be done by the manipulation, I still think that when the displaced parts can be returned with tolerable ease into their natural position, it is justifiable to try thus to liberate the cord from pressure, whether we believe the injury to be dislocation or fracture. And there are doubtless histories of cases in which the surgeon has found an amount of displacement of the spinous

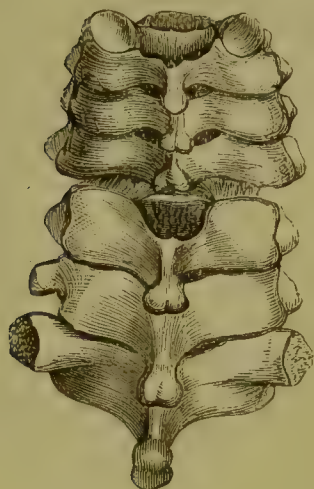


FIG. 61. Dislocation of the spine in the cervical region. The fifth and sixth cervical vertebrae are completely separated from each other, the ligamenta subflava are torn through, and the articulating processes dislocated from each other. The intervertebral substance was lacerated, and the anterior and posterior common ligaments completely torn through.—St. George's Hospital Museum, Ser. i. No. 42.



FIG. 62. Fracture of the spine—to show the displacement which very commonly takes place of a portion (or, as in this case, almost the whole) of the body of the vertebra into the spinal canal. The fractured and displaced vertebra is the seventh cervical. The intervertebral substance between the sixth and seventh cervical vertebrae was ruptured, and their laminae separated from each other by rupture of the ligamenta subflava, i.e. the fracture was complicated with dislocation, as so commonly occurs. The cord in this case was entirely disintegrated from a point opposite the fifth cervical to the third dorsal vertebra.—St. George's Hospital Museum, Ser. i. No. 56.

or transverse cervical processes which has been evidence to his mind of dislocation, or at any rate displacement of the bodies of the vertebrae, and which has been remedied by extension, the patient regaining perfect health. The histories of such cases previously published are, as I remarked in former editions of this work, in many respects of doubtful value; but I think Mr. Van Buren's case, related in the '*Lancet*,' vol. ii. 1882, p. 619, must be admitted as an indubitable instance of recovery from imminent death, due to dislocation of the cervical spine, by the reduction of the dislocation. The patient was a lad who had fallen a distance of over 20 feet, on the nape of

¹ See '*Path. Soc. Trans.*' vol. x. p. 219. The patient was under Mr. Cæsar Hawkins's care. Sir Charles Bell seems to have possessed a somewhat similar preparation, but I do not know whether it is still in existence.

² Hamilton suggests, as a diagnostic sign, the greater rigidity of the head and neck in dislocation of the cervical vertebrae. See Hamilton on '*Fractures and Dislocations*,' 1866, pp. 517 et seq., where the reader will find an excellent account of the cases of alleged reduction of such dislocations.

the neck. When admitted he was completely paralysed in all the extremities, and had abdominal respiration and priapism. An hour and a half afterwards he became rapidly worse, cyanosed, stertorous, and unable to swallow. Mr. Van Buren found marked prominence of the 5th cervical spine and displacement of the vertebra. With the help of the nurse he brought the parts into position. 'The vertebra went in with a distinct snap, and all prominence and displacement disappeared.' The lad rapidly recovered, and when seen two hours afterwards he could move his arms and legs, and said he felt quite well. He left the hospital eventually in perfect health. In any case in which the surgeon thinks it right to attempt reduction, all possible gentleness and caution should be used, and if moderate force is unsuccessful the attempt should be abandoned.

This leads us to the consideration of the treatment of fractured spine. In the first place, if the displacement cannot be remedied by extension and counter-extension, can it be by surgical operation? The proposal to 'trephine the spine'—i.e. to attempt, in one way or another, to elevate the portions which have been depressed on to the spinal marrow—has been sustained by the supposed analogy of depressed fractures of the skull, and has received the support of many famous surgeons. It is not becoming, therefore, to speak of it with disrespect. But the assumed analogy is obviously a very deceptive one, and I can find no evidence that the operation has ever been really in any degree successful; while, if unsuccessful in its object, it must tend to hasten death, for it is undeniably a very severe proceeding, requiring a long and deep incision through a large mass of muscles, and thus exhausting the patient by hæmorrhage when the rational indication of treatment is to spare his strength in every possible way. There is, in fact, little analogy between the indications which lead the surgeon to trephine the cranium and the conditions present in almost every case of fractured spine with displacement. In cases suited for the operation of trephining the skull, the brain is compressed at a single definite accessible part (of no great extent compared to the volume of the brain) by a small portion of depressed bone or by a foreign body; but its own proper tissue is believed to be only very slightly or not at all injured. In fractures of the spine, on the other hand (as may be seen in fig. 62), the displacement is generally due to projection of a portion or the whole of the body of a vertebra, and sometimes of more than one vertebra, into the spinal canal at a part utterly inaccessible, crushing and disorganising the whole spinal cord to an extent which cannot be remedied by the removal of the cause which produced it.¹ Very often the cord is entirely divided at the seat of fracture. No

Trephining
the spine.

¹ The only part of the vertebral column which is completely accessible and which can be fairly removed, when depressed on to the cord, is the arch or lamina. Now this is the part which is the most seldom affected. Mr. Le Gros Clark says:—'Of the many cases of fractured spine which I have on record, and which I have examined post-mortem, I cannot recall an instance in which the depression of the arch *alone* sufficed to account for the symptoms. I am aware that such cases are recorded, but I speak only of my own experience, and therefore I conclude that they are rare.' He goes on to show that even when the injury is a direct blow on the back of the spine, the cord is in all probability disintegrated beyond recovery. The whole discussion of this topic in Mr. Le Gros Clark's 'Lectures on the Diagnosis of Visceral Lesions,' pp. 187 et seq., is well worthy of perusal. The conclusion is as follows:—'I fear we must abandon this operation. . . . To weaken still further the remaining connexions of a broken spine; to convert a simple into a compound fracture; to expose the sheath of the cord, and possibly the cord itself; and to entail the risks attending the period of repair—cannot be regarded as circumstances of indifference. Accidentally, here and there, an instance may occur in which benefit does, or seems to, result from surgical interference: and the time may arrive when, perchance, the means of diagnosis at our command may enable us to judge with more precision of

judicious surgeon would think of trephining the skull if he believed that the brain was hopelessly lacerated—far less if he thought that there was in all probability a large mass of bone sticking into it at the base of the skull. Dr. Brown-Séquard tries to meet this argument by urging that though the laminae and spinous processes are the only parts which are accessible for removal, yet the removal of these from behind will liberate the cord from the pressure of the displaced bone in front. Even if this were so, however, it would leave a rugged fragment irritating the cord, and the prospect of benefit would not justify the additional irritation produced by the operation. It is quite true that there are cases in which the displacement of bone is less than that shown in the figure, and that the cord is not always hopelessly disorganised; but it is also true that in such cases the patient has a good prospect of survival, and it seems that under such circumstances an operation is more likely to prove the starting-point of inflammatory softening than to cure the patient. Dr. Gordon's case,¹ though an interesting one, and though some improvement seems to have followed the operation, cannot be quoted as successful, since the paralysis remained permanent; and although the operation has been repeated many times since, in no case does it seem to have been of unmistakable service. Exceptional cases may occur in which, from the nature of the accident or the appearance of the part, the surgeon may think that only a small amount of bone is implicated in the injury, and where he may determine to give the patient the poor prospect of relief which this operation holds out; but in general it will only hasten the end.

Treatment
of frac-
tured spine.

The treatment of fractures of the spine must be directed to combat the two main dangers to life which can be met by surgical treatment, viz. the tendency to cystitis, and that to sloughing; the other and still more formidable danger, from loading of the lungs, is unfortunately irremediable; but it only occurs in fractures high up. The tendency to cystitis may be partly obviated by the careful and frequent use of the catheter, and by gently washing out the bladder with acidulated water; but there is a strong disposition to low inflammation of all the mucous membranes, and especially that of the urinary tract, in this accident, so that the relief afforded can only be partial.² As the patient is not sensible to the pain of rough catheterisation, injury may easily be done unless great care is taken. But if catheterisation be neglected the inflammation may prove fatal by spreading up to the kidneys, or (as I saw in one case) by perforation of the bladder. Sloughing is a very frequent cause of death. Sloughs form on all parts exposed to pressure, but also on places (as the malleoli) where no pressure seems to have acted; so that there can be no doubt that the privation of nervous influence acts as a cause of the gangrene, as well as pressure, though the latter is a very powerful agent in producing the sloughing; and the tendency to this inflammation is much increased by neglect in nursing, whereby urine and faeces are left in the bed to irritate the skin. Scrupulous cleanliness, frequent slight changes of position, which can be effected by means of pillows inserted here and there, and by gently rolling the patient to one side or another, and the use of the water-bed

the nature and extent of the injury inflicted; but at present I cannot regard trephining the spine as brought within the pale of the justifiable operations of surgery.' The reader is also referred to the elaborate discussion of this subject in Mr. Jacobson's essay, where all the recorded cases are tabulated.

¹ 'Med.-Chir. Trans.' vol. xlix. p. 21.

² Great care must be taken that the catheter is scrupulously clean, and when not in use it should be kept in carbolised oil (1 in 20).

or water-pillow, are necessary in order to give the patient a fair chance of recovery. It would seem useful to give support to the injured portion of the spine by a splint made of gutta-percha gently moulded on to the back, and secured round the body, and several cases of recovery have been recorded under the use of the plaster-of-Paris jacket, especially in fractures of the dorsal and lumbar regions. It seems best to apply this after the first tendency to bedsores has passed over—say about a fortnight after the accident, but it has also been used immediately with success.¹

The prognosis as to recovery depends on two considerations: viz. (1) on the extent of the injury to the cord, as indicated by the completeness and immediate onset of the loss of its functions; and (2) on the level of the injury. Numerous examples are recorded in which, at various levels, the vertebral column has been fractured, yet the cord has escaped more or less entirely and the patient has survived; or where the symptoms have been at first partial, and then complete paralysis has supervened either from hæmorrhage, from inflammation, or possibly from the pressure of callus effused round the fracture, and this paralysis has subsided more or less completely and the patient has recovered. Many of these cases are quoted in Mr. Jacobson's essay, and one of the most remarkable is recorded by Mr. Jordison in the '*Lancet*,' 1882, vol. ii. p. 658. And finally there are many cases, low down in the spine, in which the patient survives, more or less completely paralysed. Mr. Jacobson goes so far as to say with regard to fractures of the lumbar spine, 'If the patient can be safely tided over the stage of bedsores and urinary troubles, it may be confidently expected that he will recover, and be able eventually to follow some light occupation.'

Penetrating wounds of the spine do not necessarily involve any injury to the spinal marrow. I have recorded some cases² in which the theca vertebralis has been opened by a stab, and large quantities of the cerebro-spinal fluid have escaped without giving rise to any serious symptoms. If, on the other hand, the cord is wounded, the symptoms will of course vary with the extent and position of the lesion. The cases hitherto published will be found in Dr. Brown-Séquard's works, and in Mr. Jacobson's essay. The prognosis is not quite so unfavourable as in fracture if the wound be carefully closed at once, and absolute rest enforced until all inflammatory symptoms have subsided, or are no longer to be apprehended.

Wounds
of the
vertebral
column.

In addition to cases which are immediately to be described in connexion with the subject of concussion of the spine, in which the symptoms are probably due to some bruising or ecchymosis of the substance of the cord or to some effusion into the membranes, there are some rare cases in which extravasation of blood takes place into the spinal canal in sufficient quantities to cause symptoms dependent on pressure on the cord. In these cases the effusion generally takes place external to the cord, and the symptoms usually do not come on until some time has elapsed after the accident, and they show a tendency to increase as more and more blood is poured out into the canal. But in some rare instances hæmorrhage takes place into the substance of the cord, partially or completely destroying it at the seat of lesion, and producing symptoms which much resemble those of fracture, and a result as fatal. In the museum of St. George's Hospital is a spinal cord, in which a mass of extravasated blood may be seen about the size of a hazel-nut, situated in the centre of the cord, opposite the fifth and the upper part of the sixth

Intra-
spinal
hæmor-
rhage.

¹ See Jacobson, op. cit. pp. 670-73.

² '*Med.-Chir. Trans.*' lxx. 155.

cervical nerves. The cord is softened around the blood and to a slight extent throughout its length. It was taken from the body of a man who fell twenty feet from a scaffold. He lived about thirty-six hours afterwards. The walls of the thorax and all the limbs were paralysed. No other injury was found at the post-mortem examination.

Concussion
of the
spine.

The term concussion of the spine is applied to a large collection of cases which differ widely from each other, and which appear to have little in common beyond the fact that they seem to have nothing to do with concussion, if by this word we understand a jarring or shaking of the constituents of the cord, without visible lesion, whereby its functions are to a greater or less extent temporarily suspended. There is nothing therefore to sanction the employment of the term but long usage and the want of a better, and because it serves to differentiate clinically a certain class of cases. It is a term which is exceedingly difficult to define. But it is usually, I imagine, applied to cases in which after injury the functions of the spinal cord are deranged, or more or less lost, but without any evidence of fracture. The symptoms to which the term concussion of the spine is applied come on either immediately on the injury or after an interval of uncertain duration. I do not know that I can do better than divide the subject in accordance with this fact, and consider first those cases of so-called concussion of the spine, in which the loss of nerve power comes on immediately on the receipt of the injury, and secondly those cases in which the appearance of this symptom is more remote.

It is to the first class of cases that the term concussion would appear to be more particularly applicable, as approaching more closely in the analogy of its symptoms to concussion of the brain. But that cases ever occur in which the tissues of the spinal marrow and its vessels are uninjured, as would be implied by the term 'concussion,' if rigidly interpreted, is quite unproven, and appears to be most unlikely, if we consider the structural relations of this organ, surrounded by fluid and fat, and connected to the sides of the canal in which it lies. It seems more probable that in the majority of these cases there has been some contusion or bruising of the delicate nervous substance, or some extravasation of blood into the theca of the cord, which has been the cause of the partial loss of function which is noticed. Mr. Page, who holds this view, states in his work on spinal injuries that he has 'doubts whether any passing paralysis following a severe blow on the vertebral column is not most likely to be due to the pressure of extravasated blood, which in course of time becomes absorbed.'

The symptoms in these cases are somewhat as follows: The patient having received some injury to his spine, either from a direct blow on the back, or from some violent twist or wrench, falls to the ground, and on attempting to rise is unable to do so, from having lost power of movement in the lower extremities. Upon examination it will be found that there is a paralysis more or less complete, and, according to the seat of the lesion, of a greater or less extent. Supposing the injury has been in the dorsi-lumbar region, there will be pain complained of in this situation, and probably local tenderness, but careful examination will fail to elicit any irregularity or other sign of mechanical injury to the vertebral column. The lower extremities will be paralysed, either partially or completely; that is to say, the patient may be entirely unable to move a single muscle in his lower limbs, or he may be able to perform some slight movement. Sensation will also probably be impaired or lost. There will be retention of urine and possibly

priapism. If the lesion is higher up in the cord, the loss of motor power and sensation will be more extensive, the muscles of the abdomen, thorax, and upper extremities being affected according to the seat of the injury. After a varying period of time, these symptoms may pass off, sensation generally returning first, or they may persist from, probably, secondary changes taking place in the structure of the cord. Or, again, the patient may partially recover his powers of movement, though they may not be completely restored, and he may suffer permanently from partial loss of power of his muscles, so as to be compelled to walk with a shuffling unsteady gait.

A second class of cases of so-called concussion of the spine are those in which the symptoms of loss of power do not appear until after an interval of uncertain duration. These cases have acquired great surgical and even public interest of late, from the frequency with which they really occur, and from the frequency also with which they are alleged more or less falsely to have occurred, in cases of railway injury. Amongst these cases there appear to be two distinct classes, one in which there has been a violent wrench and strain of the spinal column, accompanied by shock, and in which there follows a condition of nerve-exhaustion, with pseudo-paralytic symptoms, but without any morbid change or lesion of the cord itself; and another in which the symptoms are probably due to inflammatory changes in the cord or its membranes. It is quite clear that neither of these classes of cases ought to be denominated 'concussion' of the spine. The first of these has been ably described by Mr. Page, under the name of *spinal injuries of railway collisions*, and he is inclined to attribute all cases of so-called spinal concussion from railway collision to this class. He says, 'The mode of accident is precisely such as would be expected to give rise to spinal wrench or sprain, for the victim of a collision is thrown backwards and forwards in the carriage, and during this violence, against which he is wellnigh powerless, the muscles and ligaments of the spine, as of other parts, are 'set' or unconsciously contracted, in order to render the spinal column rigid; and thus it happens that the brunt of the violence falls on those structures whose office it then is to prevent undue bending of the spinal column and damage to the important organs within.' The result is spinal wrench or strain, and in consequence of the nature of the accident this is accompanied by severe shock. The shock produces a profound impression on the nervous system, followed by nerve-exhaustion (neurasthenia, as Mr. Page prefers to call it), and accompanied by nervousness, restlessness, and sleeplessness, with derangement of the circulatory and vaso-motor systems. These with the pseudo-paralytic symptoms of the spinal strain make up the sum of the symptoms in this class of 'concussion' of the spine.

But there is another series of cases often seen after railway collisions, and also after other accidents, in which the spine has been wrenched or strained, in which it would seem that the symptoms are due to inflammatory changes; that there is, in fact, either a spinal meningitis or myelitis set up, or probably both (for the two most frequently co-exist), of a very chronic nature, and leading in the cord to softening or other inflammatory changes. The great characteristic of these cases whereby they are distinguished from the preceding class is that there is a distinct period after the accident during which the patient has apparently almost, if not quite, recovered from the accident before the special symptoms come on. It may be that at the time of the accident there may have been no symptoms at all, that the patient

may believe himself to have been entirely uninjured, or if this is not the case the immediate effects pass off and leave the patient without any marked symptoms and apparently convalescent. Then insidious symptoms make their appearance, the patient is noticed not to be quite himself, not able to apply himself to business or to devote his attention long to any pursuit. There is irritability of temper, loss of memory and of bodily energy. He 'looks ill.' This condition may last for some time, it may be three or four months, during which the patient loses flesh and colour, and then more serious symptoms appear. Various disturbances of the nervous system, not only of the spinal marrow, but also of the brain, from ascending myelitis, begin to appear. There is loss of motor power, especially in the lower extremities, and the patient walks with a tottering unsteady gait; at the same time the attitude is unbending, and the spine is maintained rigid and erect. Sensation is modified or diminished. The patient complains of 'pins and needles' in his legs, of numbness, or sometimes of shooting pains down the limbs. The tendon reflexes are usually exaggerated. The sufferer steadily loses weight. He complains of inability to sleep, and, if he falls asleep, of distressing or horrifying dreams. The vision is often affected, images appear blurred and indistinct, there is more or less photophobia, and frequently *muscæ volitantes* or luminous spots before the eyes are complained of. On examining the spine one or more tender spots may be discovered by percussion or the application of a hot sponge, and there is a certain amount of rigidity, which accounts for his unbending attitude.

Prognosis. The prognosis of these injuries is a very difficult question. Those in which the symptoms come on at once seem to be on the whole more encouraging than those in which the mischief is consecutive on inflammation, probably accompanied by textural changes; and if the inflammation spreads upwards and symptoms of cerebral meningitis or softening begin to make their appearance, the prospect of recovery or even of amelioration becomes still worse. Much also will depend on the state of the general health. Those cases are the worst in which the patients' condition goes on deteriorating, and unluckily they are by no means the least common.

Treatment. The treatment of these cases at their commencement must be by rigid rest and by antiphlogistics—much as in severe sprain; and Mr. Erichsen, with great probability, suspects that many of the ill consequences which often follow on railway injuries depend on the patient having neglected at first to observe that perfect quiet which should always be enforced after such an accident. When the first acute symptoms have subsided, much benefit will probably be produced by counter-irritation and the actual cautery, and by the cautious administration of mercury in very small quantities, the perchloride being the favourite preparation. When all inflammatory symptoms have subsided, the use of strychnia is indicated, and electricity—the continuous current being in general more beneficial; and it is possible that then the patient may derive benefit from gentle exercise with all possible caution. The general health must, of course, be carefully attended to, and when he is able to move, the patient may be advised to try the effect of change of climate.

CHAPTER IX.

INJURIES OF THE FACE.

THE free vascular supply which is enjoyed by all parts of the face renders Wounds. the process of union rapid, and the prognosis of all injuries better, in this than in any other part of the body. It is true that cutaneous erysipelas is common, but it seldom produces alarming symptoms except in persons whose health is broken down by intemperance or visceral disease. Bruises are often extensive, since the large vessels lie close under the skin, surrounded by a loose cellulo-adipose structure, in which extravasation can go on to an almost unlimited extent; but it speedily subsides if the patient is in good health. All wounds ought to be immediately and accurately united; with sutures if the edges cannot otherwise be kept in exact apposition; and the sutures must be supported with harelip-pins when the flaps are heavy, or in the lips, where powerful muscles are attached to the skin. Even if the wounds be considerably contused or lacerated they may nevertheless be united. Perhaps no sloughing will ensue, or if the edges slough still the resulting deformity will most likely be less than if the flap had not been replaced. But sutures will very likely leave a mark of their own, so that they should not be used unless absolutely necessary; they should be as delicate as is consistent with security, and they ought always to be withdrawn as early as possible. Even in adults and in the lips there is no reason for leaving the harelip-pins in longer than forty-eight hours.

One of the most disagreeable complications of wounds of the face is salivary fistula. This is caused usually by a wound, but sometimes by an abscess, which lays open Stenson's duct. The saliva is constantly running out on the cheek, and the flow is increased when the patient eats or when his 'mouth waters.' If the division is complete the patient may be conscious of dryness of that side of the mouth. Salivary fistula.

In some cases mere cauterisation of the fistulous orifice, or refreshing its edges, will suffice to effect a cure. When these means fail, the disease must be treated by restoring the passage for the saliva from the gland into the mouth. For this purpose the proximal part of the duct (i.e. the part of the duct which is still in connexion with the gland) should be found by examination of the wound; then the cheek should be everted, and along the natural opening of the duct, in the interior of the mouth (which is generally found without difficulty, opposite the second upper molar tooth), a probe or leaden string is to be passed across the wound and along the duct in the direction of the gland.¹ The probe or string is fixed in its position by bending its extremity round the commissure of the lips on to the cheek, where it can be secured. When the saliva is thus guided into the mouth the fistula will probably heal, either of itself or on its edges being refreshed and brought together. In some cases the opening of the duct in the mouth cannot be

¹ Mr. H. Morris has used a catgut bougie for this purpose with success.—'Clin. Trans.' vol. xiii. p. 144.

found, and when this is the case the distal opening of the duct as well as the proximal must be sought in the wound; or if that part of the duct is obliterated, an artificial passage must be made and kept open; but such cases are far less promising. And indeed many cases of salivary fistula present very considerable difficulty, from the rottenness of the tissues surrounding the wounded duct, which renders them very unapt to unite when brought together, and favours the percolation of the saliva through the wound which it is intended to unite. In such cases the following method may be tried: 'The patient being seated with the head well supported by an assistant, a strong broad wooden spatula is introduced within the cheek of the affected side; this is held firmly by the assistant. The wound being then slightly elongated by incising its sides in the line of the zygomaticus major muscle, a round punch, like that used by saddlers, should be placed over the fistulous orifice, care being taken to avoid the anterior edge of the masseter muscle. Then, on pressing the punch firmly against the spatula within the mouth, a piece of the entire thickness of the cheek will be removed, and a fresh opening made directly into the mouth. The external wound, being accurately closed by sutures and adhesive strips, will usually heal kindly, and the internal opening be found to give free vent to the saliva.'¹

Foreign
bodies in
the nose
and ear.

Children very frequently pass foreign bodies into the nose or ear, which they cannot withdraw again, and which afterwards may set up grave mischief. In the nostril they give rise to foul discharge, from inflammation of the membrane, and may even produce disease of the bones. The case is constantly mistaken for one of 'ozæna,' or strumous disease—so constantly that it has become a familiar caution in surgery always to put down a case of foul discharge from one nostril in a child as being probably due to a foreign body, and to pronounce no opinion about it till after a thorough examination, for which purpose anæsthesia is generally necessary. It is generally quite easy to remove the foreign substance from the nostril, or they may be washed out by the nasal douche, the stream being sent up the sound nostril, and returned by the other. The discharge will at once subside.

Foreign bodies in the meatus auditorius are more dangerous, for they may easily cause perforation of the membrana tympani, or even cerebral mischief, by inflammation spreading through the base of the skull to the cranial sinuses. Such foreign bodies may be removed by constant syringing with warm water, or under chloroform with a pair of forceps, a bent probe, a loop of wire, or some special instrument of which several have been devised for the purpose. But if these means fail, as they often do, nothing further should be done, beyond perseverance in syringing, since harm may easily be produced by the incautious use of instruments, and in all probability suppuration will loosen the foreign substance, and then it will come away. On this subject, an interesting statement from Sir W. Dalby will be found in the 'Brit. Med. Journ.' Dec. 15, 1877. Sir W. Dalby says that no foreign body in the ear can possibly do any harm if left alone, except living insects and vegetable substances, which rapidly swell from absorption of water; but that he sees constant instances of rupture of the membrana tympani from incautious or bungling attempts to extract them, and that even fatal consequences may ensue. All attempts at extraction are in his opinion unjustifiable unless the operator have learned to use his two hands, while the external meatus is thoroughly illuminated by a mirror, worn on the forehead.

¹ Mason, 'Am. Journ. Med. Sci.' July, 1880.

The bones of the face can only be fractured by direct force, and these fractures are not so frequent as might be expected. One observation which it is necessary to bear in mind in these injuries is that the distinction which in other regions is so important between simple and compound fractures has really hardly any importance as applied to the bones of the face. Wounds of the face heal so rapidly, and the thin facial bones are so surrounded by structures rich in vessels, that compound fractures heal almost as readily as simple fractures do.

Fractures
of facial
bones.

The ossa nasi when fractured are usually also depressed, causing a flattening of the bridge of the nose and a very unpleasant deformity. The accident is a very easy one to recognise, but the treatment is not always satisfactory, for these delicate bones are often comminuted as well as fractured, and it is very difficult to adjust the fragments properly.

Of the
ossa nasi.

All possible care, however, should be bestowed on the restoration of all the fragments to their proper position, by means of a curved staff or a female catheter introduced up the nostril. If it is otherwise impossible to keep the fragments in their place, the surgeon may try to support them by some substance introduced into the nostril; but Mr. Holmes Coote justly says that 'plugging of the nostril should not be resorted to except in cases of severe displacement, for it causes the patient great discomfort, and not uncommonly fails to effect the purpose for which it is used.' If it is found necessary to introduce a foreign body, it should be removed after a few days. The fracture unites very rapidly. In some cases the cartilages only are broken or bent. The treatment, however, of these cases must be conducted on the same principles. The septum is of course usually involved in the fracture and displacement, and great care must be bestowed in order, if possible, to keep it straight while the process of union is going on. When the case is first seen the septum should be straightened by means of a flat pair of forceps, and the broken pieces of the nasal bones replaced. In a case under my care in which there was great deviation of the nose, I obtained a very good result by the use of a frame adapted to the head, and carrying two flat plates, something like the blades of a pair of flat forceps, between which the nose was kept evenly and comfortably supported for about three weeks, till all tendency to lateral displacement had disappeared. In other cases an apparatus like that figured in Mr. Spencer Watson's work¹ may be employed to make pressure on the projected bone and gradually restore it to its natural position. Mr. W. Adams² has described a screw steel apparatus for supporting the fragments in these cases, which is to be worn for two or three days, and then replaced by an ivory plug. And, no doubt, in some complicated cases the use of a metallic or glass support is necessary; though in those where the fracture is only single, and the septum is not much deviated, it may be superfluous.

Fractures of the upper jaw are accidents of little moment unless the displacement is such as to produce much change in the features. I remember a case in which, a carriage-wheel having passed over the face, most of the bones seemed to be separated from the skull, and on recovery a peculiar and most disagreeable lengthening of the face was left. Such deformities are very difficult indeed to avoid, for there is little means of acting on the upper jaw from any side so as to replace its fragments when once driven in.

Of the
upper jaw.

Fractures of the malar bone are rare, and are usually caused by considerable violence. The only point of interest in their pathology is one illus-

Of the
malar
bone and
zygoma.

¹ 'On Diseases of the Nose,' 1875, p. 308.

² 'Lancet,' 1875, vol. i. p. 649.

trated by a case which I published many years ago,¹ where a gentleman who had fallen from his horse and had sustained fatal injury to the brain presented an orbital ecchymosis exactly resembling that which attends on a fracture of the base of the skull. On post-mortem examination the bleeding was found to depend on a fracture traversing the malar bone near its junction with the frontal.

Fracture of the zygoma is exceedingly rare, and it is said that in some cases displacement is produced by the action of the fibres of the masseter muscle implanted into the fractured part, but I have no personal experience of this injury. The displacement, when recognised, must be remedied by careful manipulation under anæsthesia. Replacement by the insertion of a sharp metallic point into the displaced fragment and traction upon it has been spoken of.

Of the
lower jaw.

By far the most common fracture in the face is that of the lower jaw. This is usually caused by a very heavy blow, such as the kick of a horse, though as curiosities cases are recorded in which muscular action is said to have caused it. It is frequently in some sense compound, that is, the line of fracture communicates with the air in the cavity of the mouth, for the soft coverings of the jaw are very commonly torn. But the fracture almost always unites after the manner of a simple fracture. In some complicated injuries, however, the comminuted portions will exfoliate. Any part of the bone may be broken. There are cases in which only the alveolar edge is broken off, but the continuity of the bone is not interrupted, since its base is not broken. Such accidents are rare in the present day, but were said to be common when 'the key' was in ordinary use in extracting teeth. Mastication will be painful or impossible at first, but as the parts consolidate the patient will completely recover, though perhaps with the loss of some of the teeth. Another rare fracture of the jaw is that of its neck.² It is not difficult to diagnose, by following the ascending ramus upwards with the finger introduced into the mouth. I once dissected a specimen of this injury in which the broken ramus had protruded through the meatus auditorius externus, and had so irritated its lining membrane as to give rise to a catarrhal discharge very much resembling that which is seen in some fractures of the base of the skull.³ Another fracture is that through the angle between the body and ascending ramus, and in this there is not much displacement, since the masseter and internal pterygoid inserted on either side keep the parts in position. The fractures which occur between the angle and symphysis are generally much displaced, and especially when, as very commonly happens, there is fracture on both sides—the central piece being drawn down by the hyoid muscles in addition to the displacement caused by the force of the blow. Fracture often traverses the bone at or close to the symphysis, and this fracture will not be much displaced unless the force has been unusually severe, since the muscles of the two sides will balance each other.

Fracture of the coronoid process is a rare accident, but one which is illustrated by a preparation in the Museum of King's College Hospital, of which

¹ 'Brit. Med. Journ.' 1855, p. 967.

² Mr. Heath says that, judging from the number of Museum specimens which exist of it, this injury is probably not so uncommon as it is represented. I can only say that it seems rarely met with in extensive hospital practice, where other fractures of the jaw are common.

³ 'Path. Soc. Trans.' vol. xii. p. 159.

Mr. Heath gives a representation, copied from Sir W. Fergusson's 'Practical Surgery.' The former author thus speaks on the subject of this rare injury: 'The fragment would, no doubt, be drawn upwards and backwards by the temporal muscle, and might be felt in its new situation, though this displacement would probably be limited by the very tough and tendinous fibres which are so closely connected with the bone, forming the insertion of the temporal muscle and reaching down to the last molar tooth. According to Sanson fractures of the coronoid process do not admit of union.'¹ I venture to think that the latter statement is entirely unsupported, and that the idea that fractures of the coronoid process of the jaw do not unite by bone—though it has been copied from one author to another till it has become one of the *loci communes* of surgery—rests on no evidence. If the fragment were much drawn up, the fracture would unite by ligament; but there is no proof that this displacement usually occurs.

Fractures of the lower jaw are often multiple or comminuted. This is the case, of course, in gunshot fractures almost always, but not infrequently in those caused by the passage of wheels over the face or by other unusual violence. And the nature of the displacement, as well as the amount of deformity resulting, is greatly influenced by this circumstance. It is mainly in these more complicated fractures that non-union is to be apprehended.

The state of the teeth should always be carefully considered in cases of fractured jaw, and any which are so displaced as to interfere with union, or so injured as to be useless, had better be removed at once.

Diagnosis
and treat-
ment.

The symptoms of fractured jaw are usually very plain. The patient will feel very great pain in trying to open his mouth, the saliva will very probably drivel, the line of the teeth will be broken, and one or more will very likely be loose or be knocked out; there will be displacement as described above, and crepitus will be easily felt on manipulating the parts into position. If the fracture be comminuted, the diagnosis will be still more easy.

The treatment consists in replacing the parts by proper manipulation, which is seldom difficult in uncomplicated fracture, and then in the simpler injuries nothing further is necessary than to put up the parts in a jaw-bandage, i.e. a four-tailed bandage, with a hole cut in the centre to receive the chin, the tails crossing each other, one pair tied behind the occiput (sometimes for more security brought thence over the forehead), the other over the vertex. Inside this may be placed a guttapercha or pasteboard splint moulded so as to fit the chin.² The teeth of the lower jaw are thus brought into close apposition with those of the upper, which serve in some measure as a splint for them, fixing them in their natural position. For the efficiency of this treatment it is clear that the teeth must be kept together, i.e. that the patient must not be allowed to open his mouth. He must, therefore, be content with such fluid or semi-fluid nourishment as he can suck in through any gaps there may be in his teeth or can pass in through the hiatus behind the molars. After the first fortnight perhaps a little movement of the jaw may be allowed. In a period of from three to four weeks from the accident

¹ 'Injuries and Diseases of the Jaws,' 2nd ed. p. 14.

² An oval piece of pasteboard is taken of appropriate size, and a cut is made on either side in the long axis of the oval, leaving a part in the centre undivided. The pasteboard is softened, and this central part is moulded on to the chin, while the divided ends overlap each other and hold the splint in place.

the parts will become sufficiently united to dispense with the bandage, but the patient may prudently wear a handkerchief, in order to prevent his opening his mouth too far or using the teeth too violently.

Complicated fractures of the jaw are sometimes very hard to deal with. If sound teeth remain on both sides of the line of fracture they may be tied together with a piece of wire. The plan, however, is not a good one, as it tends to loosen the teeth, and the wire being then slackened the displacement recurs. Mr. H. O. Thomas of Liverpool has dwelt strongly on the advantages, in cases of compound and much-displaced fractures, of wiring the fragments together, for which purpose he drills a hole through the fragments and passes an annealed silver wire $\frac{1}{32}$ of an inch in diameter through both of them. The wire is then so twisted at either end as to allow of its being tightened (which will become necessary in a few days, from the subsidence of effusion between the fragments), and also of easy removal. The advantages claimed for this method are greater nicety of adaptation and more comfort to the patient, who is able to masticate easily.¹ In the case of non-union of fractures, I have already spoken of the benefit which is often derived from pegging or drilling the fragments together (page 136). Where the teeth, or most of them, remain in the jaw, and where the bone is not much comminuted, it seems that Hammond's splint is the most useful and the easiest to manufacture. Its application is thus described by Mr. Jacobson:²—'While the patient is under an anæsthetic, the teeth on either side of the fracture being tied together temporarily, and the fragments firmly supported, a frame of strong iron wire is, by means of small curved pliers, adjusted to the fractured jaw by being bent so as to encircle all or any desired number of teeth on a level with their necks. A plan very much to be preferred is to take first a soft wax impression of the teeth, then to cast this in plaster of Paris and to adjust the frame on the cast. The frame, the ends being joined by silver solder, is then slipped over the teeth, steadied by an assistant, while it is tied in place by short pieces of much thinner wire passed round each tooth and interlacing with the frame. These pieces of wire should be pointed obliquely, so as to pass easily between the teeth, especially where the intervals between the necks are very narrow, as in front. If by accident they are here and there passed through the gum itself it will not interfere with the action of the splint. The ends of each of these binding-wires are then twisted up in front, at first nearly tight, four or five wires on each side of the mouth being inserted and partly tightened. The wires on each side of the mouth are taken alternately, and finally tightened so as to exert equal pressure, care being taken not to overtwist and break them. The twisted ends are then cut short within about a quarter of an inch of the necks of the teeth, and turned downwards so as to be beneath the frame itself, and in close contact with it.'

In cases where there is much comminution these simpler plans will not succeed, and there is much danger either that the fracture will not unite at all or that great deformity will result. In such cases a mould must be constructed in vulcanite, or better in thin metal, silver or gold. Such moulds are made on one of two principles, i.e. they either use the teeth of the upper

¹ For further details I must refer to the original paper in the 'Lancet' for 1867, or to a tract entitled 'Cases in Surgery illustrative of a new method of applying the wire ligature in compound fractures of the lower jaw,' 2nd ed., Liverpool, 1875.

² 'Syst. of Surg.' 3rd ed. i. 724. From Mr. Moon's article in 'Guy's Hospital Reports,' 1873.

jaw as a base on which the mould is fixed above, while its lower part carries cavities for the reception of the teeth of the lower jaw, and they are confined in those cavities by a splint and bandage externally, the mould itself being attached to the splint by an arm at either corner of the mouth; or else the support of the upper jaw is dispensed with—a frame is moulded to the chin; an arm projects from this frame on either side and carries a mould, in which the teeth are received. In the former plan (the interdental splint, as it is called) it may even be possible to dispense with any external support, and to confine the apparatus entirely within the mouth. The convenience of these apparatus which are moulded on to the teeth is, that they do not prevent the patient from opening his mouth, and therefore they cause no impediment to speaking or mastication, for the portions which fit on to the lower and upper teeth are hinged together inside the mouth. But they require more skill in modelling than a surgeon usually possesses, so that the services of a skilled dentist have to be called in, and great care must be taken to reduce the fracture completely under chloroform before the mould is taken. If the bone is much comminuted it may be necessary to wire, or peg, some of the fragments together inside the mould. The treatment of these complicated cases must extend over a much longer period than that of simple fracture, especially when some of the fragments become necrosed. In the celebrated case of Mr. Seward, the American statesman, who suffered from a fracture of the lower jaw complicated by a subsequent gunshot wound of the same

part, the interdental splint was worn for more than a year. The reader will find all details, which space forbids me from inserting here, carefully and clearly described in a paper by Mr. Berkeley Hill in the 'Brit. Med. Journ.' for February and March 1867, and in Mr. Heath's work already referred to.



FIG. 63. Unilateral dislocation of the lower jaw.—From R. W. Smith.

Dislocation of the jaw is an injury which is not very common, but which gives rise to striking symptoms, and which, when it has once occurred, is liable to recur from very slight causes. It is generally caused by a blow or a fall on the chin with the mouth wide open, whereby the condyle of the jaw is

Dislocation of the jaw.

driven forward; but when the jaw has once been dislocated the displacement is easily reproduced in extreme yawning, and the accident also often occurs for the first time during yawning or in convulsions. The symptoms are very characteristic. If both joints be dislocated, as is most usually the case,¹ the mouth is widely open, and cannot be closed; the chin is advanced; the

¹ Mr. Bryant says two out of every three cases are bilateral; while Nélaton believes that the frequency of bilateral is only a little greater than that of unilateral dislocation.

saliva dribbles, partly as a consequence of increased secretion from irritation of the parotid gland, partly from deficient power of deglutition; the speech is almost unintelligible; there is a hollow just in front of the ear where the joint should be, and a prominence near the malar protuberance caused by the displaced coronoid process over which the fibres of the temporal muscle are stretched. If the dislocation is unilateral the chin is generally much twisted to the opposite side, as in the annexed drawing; though this, as Mr. Hey states, is not always the case; but he points out as an infallible sign of the dislocation the hollow which is to be felt behind the dislocated condyle. Prof. Smith, in quoting these observations of Mr. Hey, says that he has seen, in a dislocation of the right condyle, the efforts at reduction applied to the left. I conclude, however, that Mr. Hey's remarks must apply to old dislocations; for if the dislocation be left unreduced (which strangely enough is sometimes the case), the patient recovers the power of closing the mouth and retaining the saliva, and to a great extent that of perfect articulation.¹

Reduction.

Reduction is generally very easy, and has been effected even as late as four months after the injury. The surgeon grasps the chin and jaw in both hands, the thumbs resting inside the mouth on the angle between the body and ramus behind the last molar teeth, while the fingers embrace the chin. The thumbs are of course protected with a cloth, or they would be severely bitten as the jaw returns to its place. The perpendicular ramus is thus forced down, whereby the condyle is disengaged from its unnatural position, while the chin is pushed back and raised; and when the condyle is thus disengaged the tense fibres of the temporal and masseter muscles will contract and replace the jaw with a snap. The process in unilateral dislocation is similar, the main point being to disengage the condyle, and then to assist the reduction by pressing the chin in the reverse direction to that in which it has been thrown by the violence. Some surgeons introduce the end of a piece of wood about a foot long between the molar teeth; by raising the other end, the point resting on the lower molars is depressed, and the upper teeth acting as a fulcrum, the jaw is levered back into its place. Sir A. Cooper directs that the posterior teeth should be separated from each other by corks, while the chin is raised by the hands. In a case of four months' standing Mr. Pollock effected reduction by separating the jaws with wedges inserted between the molar teeth, while he drew the chin upwards by means of the strap of a tourniquet applied round the head and beneath the jaw, so that the screw might exert its power upon the dislocated bone. In one of eighteen weeks' standing Mr. Golding Bird effected reduction by direct pressure on the coronoid process as recommended by Nélaton.²

Obstacles to reduction.

Two views have prevailed as to the mechanism of this dislocation, and therefore as to the obstacles to its reduction; and I have thought it better to preface what I have to say on this point by describing the method of reduction, since the latter has considerable bearing on the question of the pathology of the injury. Nélaton, who has given great attention to this subject, and whose description of the injury is well worthy of careful study,³ remarks on the rarity of the dislocation, and on the fact that there is very little to separate the displacement of luxation from the ordinary and natural displacement of the condyle forwards which occurs in all cases of extreme separation of the jaws, and which requires no reduction, since the bone returns

¹ See the fig. in Smith, *op. cit.* p. 289.

² 'Clin. Soc. Trans.' vol. xvii. p. 32.

³ 'Path. Chir.' vol. ii. p. 306, ed. 1847.

spontaneously into its place. He also shows that the ligaments are so lax (in order to allow of these natural displacements) as to oppose no obstacle to reduction; and the projection of bone (*eminentia articularis*) in front of the glenoid cavity is also too slight to have much influence in that direction. But he says if the anterior part of the capsule be cut through on the dead subject, and the condyle of the jaw be forced through it far enough to bring the tip of the coronoid process in front of the malar prominence, then it will be found that if the coronoid process is long enough its summit will abut against the zygoma, and this will prevent any reduction until it has been forced back again. This view is supported by the preparation here reproduced from Malgaigne, by looking at which the reader will see at once that the displaced coronoid process will effectually prevent reduction; but that by pressing on the angle of the jaw from within the mouth the surgeon might easily send it back again, and so far disengage it that the fibres of the temporal muscle (which in the drawing are seen bent or twisted over the tip of the process) would become straight again, and with the masseter would easily restore the bone to its place as the chin was lifted.

But, on the other hand, Maisonneuve and Otto Weber have experimented upon the dead body, and deny that any such locking of the coronoid process against the zygomatic arch exists, at least in all cases. They would, therefore, attribute the mechanism of the dislocation to the tension of the mus-

cles. In Nélaton's view, then, dislocation can only occur when the coronoid process is so long as to catch against the zygomatic arch; and it is to the rarity of this peculiarity of the coronoid process that Nélaton attributes the rarity of the injury; while in the other view the dislocation is caused by the muscles drawing the displaced condyle through the lacerated capsule, and fixing it there by their contraction;¹ and in support of this view the fact is mentioned that Roser was unable to reduce a dislocation of eight weeks' standing, even after cutting through both coronoid processes from within the mouth. I must refer the reader who wishes to follow the subject more minutely to Mr. Heath's work.

In the ordinary dislocation the interarticular cartilage re-

Subluxation.



FIG. 64. Dislocation of the lower jaw.—From Malgaigne. In this case the jaw had been often dislocated. The ligaments are entire. The condyles do not appear to have been thrown further forward than in ordinary yawning, but the coronoid processes, which are very much pushed upwards and remarkably nearer the condyles than in the ordinary bone, ride up greatly over the malar bone, so as to lie external to the malar prominence. The patient was under Nélaton's care.—'Rev. Med. Chir.' vol. vi. p. 286.

remains attached to the condyle; but there is a condition described by Sir A. Cooper as subluxation, in which he says, 'the jaw appears to quit the interarticular cartilage, slipping before its edge and locking the jaw with the

¹ That is to say, the external pterygoid muscle would draw the condyle directly forward, while the masseter, temporal, and internal pterygoid would fix the bone against the base of the skull.

mouth slightly opened.' He also points out that this usually subsides of itself, but says that he has seen it persist for a length of time, and the motion of the jaw and the power of closing the mouth have still returned. If necessary, it may generally be easily reduced by drawing the jaw directly downwards and then manipulating it into place. Mr. Annandale records two cases in which he cut down behind the external lateral ligament and fixed the displaced cartilage in position by means of a fine catgut suture.¹

Somewhat allied to this is the *snapping* which Sir A. Cooper describes as felt in the joint, accompanied with some amount of pain, in young women and others of relaxed fibre, and which will subside spontaneously if the parts acquire more strength. 'Hamilton says that he frequently suffered from the affection when a youth, but as he became older the annoyance ceased without any special treatment.' Sir Astley prescribes ammonia and steel, shower-baths, and a blister.

¹ 'Lancet,' Feb. 26, 1887.

CHAPTER X.

INJURIES OF THE NECK.

SPRAINS, contusions, and superficial wounds of the neck present no features which render them worthy of special description; but the wounds which lay open the deeper structures, such as the windpipe, the pharynx, and œsophagus, or the great vessels, must be studied separately; and as these wounds are most commonly suicidal, it is better to describe the usual features and the proper treatment of cut-throat. The same principles are easily applied to the somewhat rare cases in which similar injuries occur accidentally. One point which may be noticed in stab-wounds of the upper part of the neck with arterial bleeding is the impossibility in many cases of distinguishing the exact source of hæmorrhage, so numerous are the great vessels in that neighbourhood. In such cases it is justifiable to tie the common carotid, and the operation has often proved successful; but Mr. Cripps¹ has shown that it is better in most cases to apply the ligature to the external carotid, since the wounded vessel is usually a branch of the latter; and the same view has been supported by Maisonneuve, Guyon, and Fischer.

Wounds of
the neck.
Cut-throat.

The wound in cut-throat is more commonly situated in the laryngeal than the tracheal region. This is accounted for partly by the greater prominence of that region, and partly by the easier accessibility of the air-tube there; for suicides very often think that a wound of the windpipe is necessarily fatal, and that therefore they can better accomplish their purpose by cutting through or near the thyroid cartilage. For the same reason the carotid artery usually escapes injury, since it becomes relatively deeper at that part; at least, though not really farther from the surface, it is farther from the middle line as it ascends from the level of the cricoid cartilage; and as the cut is begun not very far on the left side of the middle line, it usually fails to hit the left carotid, while the force becomes exhausted and the cut ceases before the right carotid is reached. Still, I have seen a case in which both the common carotids and both jugular veins were divided. Wounds in which the carotid artery even of one side is not at all freely opened generally prove fatal before medical aid is summoned. Otherwise, the first thing, of course, is to stop all arterial bleeding, and it is not often difficult to secure the wounded vessel, for the parts have probably been freely divided and will gape widely. But the lingual artery is more commonly wounded than any other, or the superior thyroid may be divided, or the facial. Having secured the arteries the surgeon must attend to the veins. They can generally be commanded by pressure with a graduated compress, but I see no danger in tying them; and as this makes them almost absolutely secure from any irregular impulse on the patient's part, it seems far better to include any considerable vein which may be bleeding freely in a ligature of carbolic catgut, or silk, with the

¹ 'Med.-Chir. Trans.' lxi. 229. See also a very interesting case under Mr. Rivington reported in 'Clin. Soc. Trans.' vol. xvii. p. 79, in which the external carotid artery was wounded in the parotid gland, and in which the surgeon placed a temporary ligature on the common carotid (or possibly on the external carotid near its origin), tied the wounded artery above and below the injury, and then took off the ligature from the trunk vessel.

ends cut short. The condition of the air-tube next demands attention. If it has entirely escaped, the injury (apart from the general condition of the patient) can hardly be regarded as serious; but generally it is perforated more or less extensively, as will be evident by the whistling of the air in the wound. If this perforation is simple, and especially if it involves only soft parts, the knife having passed between the cartilages, it will rapidly close. But often the weapon used has been blunt, the force considerable, and the attempt repeated more than once; hence the cartilages are often hacked and fractured as well as cut. Loose portions hang down, partly obstructing respiration even at first, and any such obstruction will increase as the tissues around the loose pieces swell with œdema or inflammation. This displacement of portions is especially liable to take place when the wound has gone backwards far enough to injure the epiglottis, or when the arytenoid cartilages have been cut into. When the epiglottis is trepanned upon, the wound often also lays open the mouth, and a piece of the tongue or of the floor of the mouth may fall back over the air-tube. Finally, the wound may pass through the back of the air-tube into the pharynx, or, more commonly, into the œsophagus; and the latter may even be completely severed without any large blood-vessel having been wounded.

When the air-passages have been opened there is danger in the first instance of asphyxia from the blood running down the trachea and filling the air-passages. Even a small quantity of blood, under these circumstances, is sufficient to cause death. Later on, if the wound is above the level of the vocal cords, there is a risk of acute inflammatory œdema of the glottis from exposure to the air. The loose submucous cellular tissue becomes infiltrated with inflammatory products and much swollen, blocking the rima glottidis, and causing death from asphyxia, often with great rapidity.

The treatment of the simpler wounds where the windpipe is not injured is merely that of similar wounds in any other part. They may be brought together with sutures or strapping, the patient's head being drawn down towards his chest, and fixed there. For this purpose a bandage is passed round the head, and is attached, by means of two lateral strips, to another bandage going round the chest. In the first dressing of cases presenting unusual complications anæsthesia may be useful.

Sutures in
cut-throat.

In cases where the windpipe is opened it is better to avoid sutures—at least, there is a traditional horror of them, and they are said to lead to erysipelas, and to produce a tendency to emphysema, and so to obstruction of the discharges from the wound and even of the breathing. How far all this is true I cannot say. Sutures are in ordinary cases unnecessary, for the edges of the wound can be kept tolerably in apposition without them; and as primary union can hardly be anticipated, there is no motive for sewing the edges together. They are therefore rarely used in such cases, and we have little experience of their alleged ill-consequences. But in complicated cases, where fragments of cartilage or portions of the tongue or mouth cannot otherwise be kept out of the air-passages, sutures must be employed to support them, and I cannot say that they seem really to do much harm.

There are cases in which the obstruction to respiration from such detached portions is so great that it is better to insert a cannula into the lower portion of the windpipe through the wound, or to perform tracheotomy, after which the displaced portions can be better manipulated into position and kept in place.

In wounds of the gullet the chief anxiety of the surgeon is to get the

patient to take sufficient nourishment, and yet not to interfere with the closure of the opening. I must remind the reader that the mere fact of the escape of fluid nourishment by the wound does not at all prove that the gullet is opened. The opening may be in the mouth, or there may even be no wound at all except that in the larynx. We see the same thing constantly after laryngotomy. The folds which connect the larynx to the mouth get inflamed, the larynx is no longer raised under cover of the hyoid bone, and drink runs into it and escapes by the wound. It is a distressing but not a very dangerous complication, and may be expected to disappear in a few days. Meanwhile, if the patient is thereby hindered from taking nourishment which is necessary for his life, he must be fed by the stomach-pump, or by means of a catheter passed through the nostril into the œsophagus past the wound, and retained there. By means of this, fluid nourishment can be injected as often as is deemed necessary. If the œsophagus is wounded, and the wound is fairly within reach, it would be better, I think, to bring its edges into apposition with one or two carbolised gut sutures before dressing the rest of the wound, for the sutures require no removal, and will hold the parts together and allow of their speedy union. In a patient under my care the wound, passing through the thyro-hyoid membrane, had completely severed the pharynx, exposing the vertebral column. The larynx and lower part of the pharynx had receded towards the thorax for $1\frac{1}{2}$ inch. The divided edges were united with fine catgut suture, and the larynx held in position by a silk ligature passed through the upper part of the thyroid cartilage and over the hyoid bone. Laryngotomy was performed, and a tube passed through the nose into the œsophagus, by which the patient was fed for twelve days. He recovered perfectly.¹ The treatment must be the same as after œsophagotomy, i.e. the wound must be disturbed as little as possible, yet the patient must be fed. It is even more necessary after suicidal than after operative wounds of the œsophagus that the patient should be well supported; and hence it is usually more advisable even from the first to pass a small tube or catheter beyond the wound (taking great care to keep it against the spine, so as not to touch the wound if it can possibly be helped), and thus to fill the stomach moderately and slowly with concentrated nutriment twice a day. Great care must be taken not to pass the tube through the wound, and especially to avoid the air-passages.²

In themselves all wounds of the throat which are not immediately fatal may be expected to do better, *cæteris paribus*, than those in any other region of the body, except perhaps the face. It is true that diffuse inflammation when it attacks the cellular tissue of the neck is peculiarly fatal, but it is a rare complication of these wounds in healthy subjects. The experience of Larry, Langenbeck, Dieffenbach, and others in the extirpation of large tumours from the neck, proves that if the immediate dangers of these formidable operations are avoided, the cases do perhaps better than any others in surgery.³ But the state both of mind and body of the unhappy victims of cut-throat is far from healthy. Many have a desire for death, which seems often to lead to its own fulfilment; others are broken down in constitution

¹ See also a case by Dr. Gairdner, 'Edinb. Med. and Surg. Journ.' vol. xvi. p. 353.

² One of our museums contains, I believe, a preparation showing the bronchial tubes of the lungs filled with plaster of Paris, injected through a stomach-pump tube, which it was intended to pass into the stomach in a case of poisoning. Such an accident might much more readily occur in cut-throat.

³ See 'Syst. of Surg.' 3rd ed. vol. iii. p. 886.

by years of intemperance; in others delirium tremens supervenes, or the wound has been inflicted during an access of delirium; and some are obstinately bent on destroying themselves, and unless closely watched will commit some renewed attempt on their lives or tear open the healing wound. Much care, therefore, is required in these cases; careful nursing, the judicious use of opium or other sedatives, and a liberal supply of nutriment in small quantities and at repeated intervals.

After-com-
plications.

If the patient has escaped the first dangers of the wound he may yet be troubled by its remoter consequences. Of these the commonest is fistula, either communicating with the œsophagus or trachea, or sometimes leading from the one into the other. Tracheal fistula may often be closed by a plastic operation, but the fistulæ which communicate with the œsophagus are permanent, and if they are so free as to prevent the patient from taking food at all, the only thing that can be done is to feed him with the stomach-pump. He can generally learn to pass this for himself, and indeed often more dexterously than the surgeon can pass it for him; and I have seen life thus supported and the patient keep his strength and flesh apparently undiminished for nearly a year, after which he passed out of observation. In this case the œsophagus had been so freely opened that nothing could be swallowed.

Another distressing complication is the loss of voice, and sometimes the growing dyspnœa which follows on the cicatrisation of the wound in the air-passage. This arises from various causes: either from narrowing of the tube in consequence of the cicatrisation which follows free (possibly complete) division of its walls, or from irregular union of wounds implicating the vocal cords, or from permanent displacement of detached portions, or from granulations springing into and obstructing the glottis. The occurrence of these irregularities in union furnishes a strong motive for uniting the wound in the larynx or trachea accurately with sutures at once whenever this is practicable, and especially when the trachea is entirely divided. The treatment of granulations obstructing the glottis will more fitly be considered in discussing the general subject of TRACHEOTOMY. Of course, when it is necessary to relieve dyspnœa in any of these conditions the windpipe must be opened below, as a preliminary step in the treatment of the cause of obstruction.

Other complications, such as abscess extending down the neck,¹ inflammation running along the trachea to the lungs, or inflammatory œdema making pressure on the neighbouring parts, must be treated on general principles.

Contusions
of the
larynx.

Contusions of the larynx without fracture are generally produced in attempts at strangulation, or throttling. They cause temporary pain and loss of voice, but rarely lead to any further ill-consequences, and require only rest and soothing applications.

Fracture
of the
hyoid
bone.

The hyoid bone and the cartilages of the larynx are occasionally, though rarely, fractured by direct violence, such as grasping the person by the throat, attempts at strangulation, blows, and falls on projecting objects. The hyoid bone is said to be often fractured in judicial hanging. Fracture of this bone produces great distress when the fragments are driven inwards, and especially if the mucous membrane is lacerated. All movements of the tongue, all

¹ Such abscesses sometimes pass down to the pleura, and from the external surface of that membrane the inflammation is propagated to its cavity.

attempts to swallow or speak, are attended with much pain and difficulty. The injury is easy to diagnose by the separation and mobility of the fragments, and crepitus may be obtained when they have been restored to position, which is generally quite easy. If there should be any difficulty, an anæsthetic should be administered, the mouth fully opened and kept so by means of a gag, while the fragments are disengaged by one finger in the mouth and another externally. After reduction the parts are to be kept perfectly quiet. The patient's instinct will prevent him from talking or other voluntary movements so long as they are painful, and he must be fed with sops, conveyed well into the back of the mouth. In about a fortnight the parts will be so far consolidated that much of the inconvenience will have passed by, and the accident is not likely to lead to serious consequences.

Fractures of the laryngeal cartilages or of the trachea are of more serious import than those of the hyoid bone, and when the fragments are displaced so far as to penetrate the lining membrane of the air-passages active and immediate treatment is necessary. The injury most frequently affects the thyroid,

Fracture of the laryngeal cartilages and trachea.

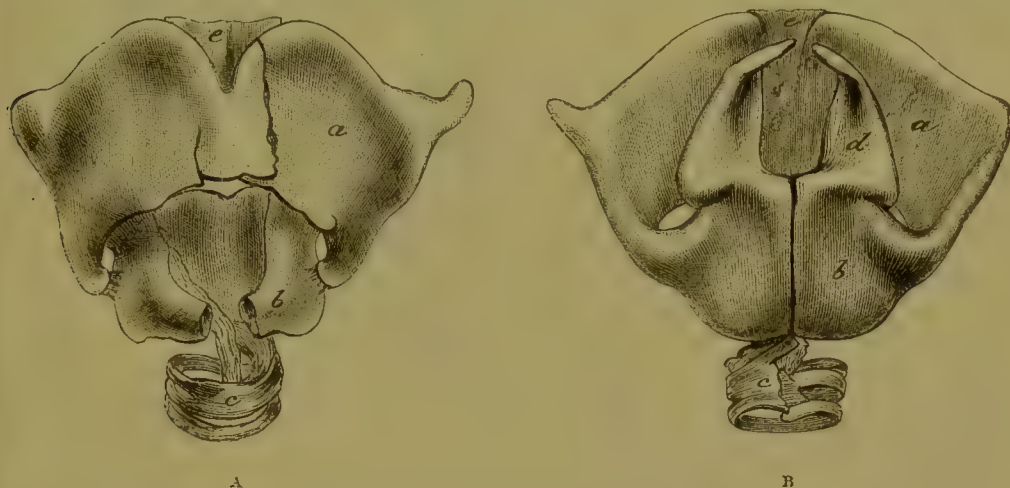


FIG. 65. A front, and B back, view of a preparation of extensive fracture of the thyroid and cricoid cartilages, taken from the body of a person who was murdered by her cook. Death resulted, in all probability, from the violence inflicted on the larynx. The hyoid bone was also fractured and comminuted, but is not shown here.—From a preparation in the Museum of St. George's Hospital. *a*, thyroid; *b*, cricoid; *c*, trachea; *d*, arytenoid cartilage; *e*, epiglottis.

and next the cricoid cartilage. Pain and dyspnœa follow the fracture; and if the mucous membrane is lacerated there is blood-spitting, constant cough, and frequently difficulty of breathing, which may rapidly increase and end in absolute suffocation. Of course, the nearer the injury is to the vocal cords, so much the more acute will be the symptoms, and so much the more decisive must be the treatment. The diagnosis is generally obvious.¹ Whether absolute crepitus will be distinguished depends in a great measure on the patient's age and the consequent extent of calcification in the cartilage.

The chief point in the treatment is as to the necessity or advisability of tracheotomy. An interesting collection of these cases was made some time since by Dr. Hunt,² from which it results that when the fragments are dis-

¹ Mr. Le Gros Clark gives a useful caution in the diagnosis of these injuries; that 'in moving the larynx from side to side on the cervical spine, or in deglutition, the manipulator may be deceived, especially when the larynx is large, and, in elderly persons, by the peculiar feeling of roughness and inequality which is thus elicited.'

² Out of twenty-seven cases ten recovered, six with and four without operation. Only two patients died out of eight on whom tracheotomy was performed, while out of nineteen who were not operated on fifteen died; and in no case where emphysema and bloody

placed and the mucous membrane lacerated it is always desirable to perform tracheotomy at once, since in all cases it becomes ultimately necessary; and by having an opening made at once below the seat of injury the patient is saved from the risk of sudden dyspnoea produced by an accidental displacement. When there is no evidence of such perforation the patient must be kept perfectly quiet, and the case must be watched with a view to tracheotomy if necessary.

Complete
rupture of
trachea.

Sometimes the injury has been known to involve the complete subcutaneous rupture of the trachea,¹ so that there is a large depression in the neck where the trachea should be, and the patient breathes with great difficulty by the indirect passage of air from the upper part of the windpipe through the interval, which must be partly occupied with blood, and so into the retracted lower end of the trachea. Under such circumstances not a moment should be lost in attempting to find the lower end of the trachea and fixing it by introducing a tube. The parts are to be very freely divided in the median line, and the trachea drawn up to the surface. If it is very movable and retracts easily, there is no objection that I can see to fixing it temporarily with a suture.

Foreign
bodies in
the air-
passages.

The entrance of a foreign body into the air-passages is a formidable accident, and one which not unfrequently proves fatal. It may occur at any period of life, but is more frequent in children, both from their natural want of caution and experience, and from their frequent habit of playing with things in their mouth. The accident is caused by a sudden inhalation while holding something in the mouth, as by laughing or gasping with fright while taking food, by catching a coin in the open mouth, &c.; and in some rarer cases the foreign body has been driven in from the outside, as in the case of a child who was cracking a whip in the lash of which a large copper pin had been fixed. The pin got loose, and passed through the trachea. Fortunately the surgeon recognised the small puncture, and cut down on the foreign body.²

Another comparatively frequent accident is the impaction of a large mass of food in the pharynx obstructing the upper opening of the larynx, and causing speedy death if not dislodged. The treatment is simple, if the nature of the case be recognised in time. The mass being pushed down or hooked up, the breathing may be at once restored; if not, artificial respiration is to be sedulously practised.

Foreign bodies which have passed fairly into the windpipe may be lodged in various situations. They may be detained above the rima glottidis, and then may be thrust more or less completely into the ventricle of the larynx; they may be caught between the vocal cords; may stick in the cavity of the larynx; may lie either fixed or, more commonly, loose in the trachea; or may pass down beyond the bifurcation of the trachea into one of the bronchi, or even lower, into one of the bronchial tubes of the lung itself.³

expectoration testified to perforation of the mucous membrane by the fragments did recovery ensue without tracheotomy.—'Am. Journ. Med. Sc.' April 1866. A larger collection of cases (69) is given by Mr. Durham ('Syst. of Surg.' 3rd ed. i. 749), of which fifty-three proved fatal, and it is noteworthy that all the cases (28) in which the cricoid cartilage was fractured, whether singly or along with other cartilages, died.

¹ See Mr. Halford's case, in 'Syst. of Surg.' 3rd ed. vol. i. p. 751.

² De la Martinière, 'Mém. de l'Acad. de Chir.' v. 521.

³ 'Out of twenty-one cases analysed by Professor Gross, in which death took place without operation, and without expulsion of the foreign body, in four the foreign substance was situated in the larynx; in one, partly in the trachea, partly in the larynx; in three,

The symptoms vary partly with the size and shape of the foreign body, partly with its position. The larger and rougher the foreign body is, the more acute will probably be the symptoms; the nearer it is lodged to the vocal cords, the more spasm is it likely to cause; the more firmly it is impacted in one of the bronchi, the more complete is the loss of breathing on one side.

In their most marked form the symptoms of a foreign body in the air-passages are as follows: the patient, being previously in his usual health,

has been suddenly seized with convulsive cough and dyspnœa, aggravated into severe paroxysms. At the same time it is possible that he or, if a child, his parents may know that he has swallowed something, or that something which was in his mouth has disappeared. The speech will be more or less affected, and the breathing whistling or stridulous. There may be some pain about the part where the body is lodged (probably about the thyroid cartilage), aggravated by pressure. The foreign body can in some cases be felt by exploration from the mouth, and in others can be seen by the laryngoscope. More rarely it can be felt in the neck.

The diagnosis in cases where a foreign body is not perceptible and the history is not clear (which is very commonly the case in childhood) is by no means easy. It rests mainly on the sudden accession of the symptoms during a condition of complete health, and

Diagnosis of the lodgment of a foreign body.

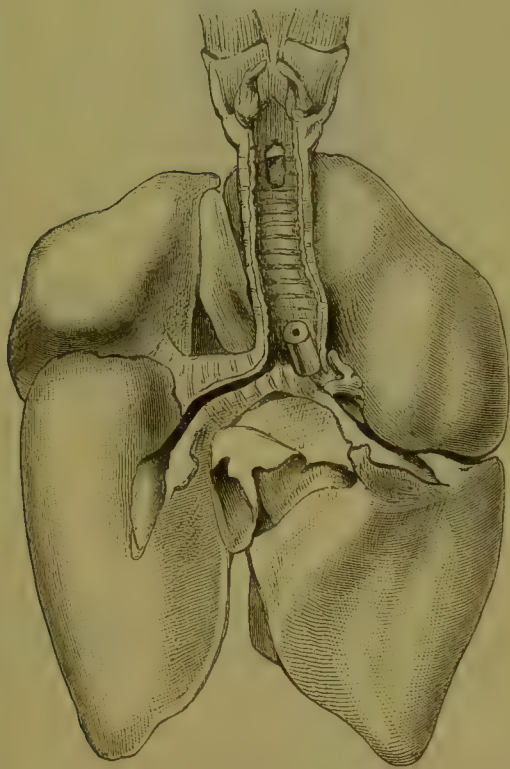


FIG. 66. From a preparation (Ser. vii, No. 79A, in St. George's Hospital Museum) showing a piece of tobacco-pipe impacted in the right bronchus of a child. The symptoms were very obscure, perhaps because the air passed through the pipe into the lung.¹ Ultimately tracheotomy was performed, but the foreign body could not be reached.

is therefore easier the sooner after the supposed accident the patient is seen. In case the history should be doubtful the diagnosis between the irritation produced by a foreign body and the dyspnœa of croup or laryngitis rests in

in the trachea; in eleven, in the right bronchial tube; in one, in the lung; in one, in the right pleural cavity.

'Out of forty-two cases subjected to operation or general treatment the extraneous substance was situated twice positively, and eleven times probably, in the right bronchial tube; four times certainly, and four times probably, in the left bronchial tube; seven times in the trachea, and fourteen in the larynx. Out of fifty-seven cases occurring during the last few years, of which I have notes, in twenty-seven the foreign body was in the larynx; in eleven in the trachea; in ten, in the right bronchus; and in nine in the left bronchus. It would thus appear that the larynx and the right bronchial tube are the most frequent situations in which foreign substances are arrested. This conclusion, however, does not precisely coincide with that derived by M. Bourdillat from the analysis of 156 cases. In eighty of these the foreign body was in the trachea; in thirty-five, in the larynx; in twenty-six, in the right bronchus; and in fifteen, in the left bronchus.'—Durham, in 'Syst. of Surg.' 3rd ed. vol. i. p. 758.

¹ The same was the case in a patient under Mr. Hulke's care ('Med.-Chir. Trans.' vol. lx. p. 91), in whom a tracheotomy tube had slipped into the bronchus.

a great measure upon the comparative absence of fever in the former case, the patient being sometimes almost well during the intervals between the spasms. In some cases, where the foreign body moves about in the trachea, the patient is himself quite conscious of its movements. When it has dropped into one of the bronchi the entrance of air into that lung is prevented, either totally or in great part, and therefore there is absence of the respiratory murmur, and of the dilatation of the lung, without dulness to percussion or any other sign of pleurisy or pneumonia.¹ In some cases a whistling and cooing rhonchus has been heard at the point where the foreign body is lodged.²

The right bronchus is more commonly the seat of lodgment than the left, since the septum is placed somewhat to the left, though the more horizontal direction of the right bronchus to some extent neutralises this tendency. (See the foot-note on the previous page.)

In cases where a perfectly confident diagnosis cannot be made, yet there seems good reason for thinking that there may be a foreign body in the windpipe, it is better to treat the patient as though this were the case, since an opening may relieve dyspnœa from other causes, and the operation does not add very much to the patient's danger.³



FIG. 67. Bifurcation of the trachea, seen from behind, showing the septum to the left of the median line, and showing also the more vertical direction of the left bronchus.—From Durham, 'Syst. of Surg.' 3rd ed. vol. i. p. 759.

Treatment.

When the diagnosis of a foreign body has been made, the surgeon should allow no delay in removing it at once. It is true that substances have remained for years in the trachea innocuous; but it is far more probable that a foreign body which may be setting up no very marked symptoms at the moment will afterwards get displaced and cause urgent, perhaps fatal, dyspnœa when there is no help at hand.

There are cases in which the foreign body can be seen with the laryngoscope and extracted by means of forceps introduced by the mouth; but these are rare. A case is recorded⁴ in which a brass ring had been lodged near the upper opening of the larynx for four years. The patient was a child 6½ years old, and was then suffering from aphonia and laryngeal spasms. The position of the ring is thus described: 'It encircled the left arytæno-epiglottidean fold and ventricular band, but, except where it passed deeply

¹ This is the case at first; as time goes on the lung becomes collapsed and dull on percussion.

² Le Gros Clark, *op. cit.* p. 237. This symptom was very plainly marked in a case under my care where a small piece of apple was lodged near the bifurcation of the trachea.

³ Mr. Barwell gives references to seven cases in which the foreign body was not found at the operation, yet the patients recovered; probably from the unnoticed escape of the substance.—'Clin. Soc. Trans.' vol. vi. p. 120.

⁴ 'London Med. Record,' April 14, 1875.

into the tissues, it did not come into contact with the larynx.' It should be remarked that the ring had a fissure at one part. Extraction by the help of the laryngoscope being found impossible, on account of the child's indocility, the foreign body was successfully removed by making a transverse incision through the thyro-hyoid membrane, drawing the epiglottis with the cushion of fat and cellular tissue at its base, downwards, and thus penetrating between the hyoid bone and epiglottis into the space above the glottis. To this operation the operator gives the name of 'subhyoidean laryngotomy,' and it is a proceeding which in rare cases may prove useful; but in general foreign bodies lodged in this situation can be extracted with forceps of appropriate shape from the mouth when the patient is fully narcotised.

If the symptoms are not very urgent (in which case the windpipe must be opened without a moment's delay) chloroform should be given; and unless the position of the foreign body is known the first step is to examine the parts as far as the finger can reach. If it cannot be extracted from the mouth, but appears to be lodged near the glottis, the cricothyroid membrane, cricoid cartilage, and in children one or two rings of the trachea, should be divided, so as to have a very free opening. Possibly the body may now be removed or may shoot out of the wound; otherwise the larynx must be examined with a large instrument, such as a female catheter,¹ and the substance pushed up through the glottis or extracted with forceps. If this cannot be done, yet the substance can be felt lodged just above the glottis, a cannula should be placed in the lower part of the wound,² the two alæ of the thyroid cartilage cautiously divided, and the foreign body picked out of the ventricle of the larynx. When the body is loose in the trachea a free opening low down will generally procure its exit.³ When in one of the bronchi all that can be done is to open the trachea as low down as is prudent, and by a very free incision. Then, if the situation of the foreign body can be ascertained by probing, it may be possible to extract it with forceps or to dislodge it with a hook; or the patient's body being inverted and shaken, the foreign substance may be discharged either from the glottis or from the wound.

Sir B. Brodie's celebrated case⁴ of Sir I. Brunel, in which a half-sovereign had dropped into the right bronchus, shows the advantages in these cases of making an opening in the trachea, even if the foreign body is not extracted from it. The inversion of the body, which before produced great dyspnœa from the coin striking on the glottis, became perfectly tolerable afterwards, and the coin dropped quietly into the mouth. The same case shows also the great difficulty which may be met with in exploring the trachea with forceps or other instruments. The walls of the air-tube are so very irritable that any contact of the instrument is sure to provoke spasmodic cough, and the instrument is as likely to poke the foreign body further down as to bring it up, besides the risk of catching the 'bifurcation of the trachea, or one of the subdivisions of the bronchus, instead of the foreign body.' So that it is better, after having made a free opening in the trachea, to try and dislodge the foreign body by changes of position, by inversion of the body, by shaking or slapping the chest, rather than to risk the evil consequences which may follow the introduction

¹ Mr. Durham recommends the ivory top of a gum catheter.

² The operation is much facilitated by having the trachea plugged by means of Trendelenburg's or Semon's tampon, so that no blood can run down the windpipe.—See a paper by me in 'Med.-Chir. Trans.' vol. lxx.

³ Mr. Hilton is in favour of making this opening transversely valvular.—'Med. Times and Gaz.' vol. i. 1867, p. 507.

⁴ 'Med.-Chir. Trans.' vol. xxvi. p. 286.

of instruments ; and if such introduction becomes necessary, to try rather to displace the body by getting a hook, wire-snare,¹ or bent probe below it than to catch it with the forceps. At the same time, as the forceps have no doubt been used successfully in such cases,² the attempt ought to be made when the circumstances call for it.

Mr. Durham says : ‘ Dr. H. B. Sands³ has pointed out that “in adults the bifurcation of the trachea and the orifice of each primary bronchus can be reached by the forefinger introduced through an ordinary tracheotomy wound ; and that when desirable the little finger can be passed upwards into the larynx, so as to detect either a foreign body or a morbid growth.” This fact may be readily verified on the cadaver, and its practical value is very great, as was well illustrated in a case under the care of Dr. Gordon Buck, in which Dr. Sands readily felt and determined the exact position of a hard india-rubber tracheotomy tube which had fallen into the trachea and become impacted in the right bronchus. The tube having been felt was easily extracted.’

Foreign bodies may also be successfully treated in some cases by inversion of the body and succussion without any previous operation. In many cases the substance has become loose and has fallen through the glottis, and the plan is well worth trying, particularly in cases where the body is smooth and heavy ; but as there is a risk that the substance, if dislodged, may be caught by the spasmodic closure of the vocal cords, and instant suffocation be thus produced, it is well before resorting to this plan to be prepared for laryngotomy in case of any such emergency.

After-con-
sequences
of lodged
foreign
body.

The after-consequences of the lodgment of a foreign body, if it be not extracted, are very various. They vary as the immediate symptoms do, with the position, size, shape, and smoothness of the substance. Pointed rough substances, wherever they may be impacted, produce a rapidly-spreading inflammation of the internal membrane of the air-passages, spreading down the trachea into the smallest bronchial tubes. On the other hand, a smooth body (like Sir I. Brunel’s half-sovereign) may remain impacted in the lower part of the trachea, in one of the bronchi, or even in a large bronchial tube of the lung itself, for a considerable period without exciting any such symptoms. Nor are cases wanting to prove the possibility of a smooth foreign substance becoming encysted or encased by inspissated mucus and remaining perfectly innocuous.⁴ But such cases are exceptional, and ought not to deter the surgeon from the necessary operation in any case in which he has certain evidence of the lodgment of a foreign body. The case far more commonly proves fatal, and death is produced in various ways. The rougher substances cause acute inflammation, as above stated, paroxysms of cough proving fatal either by loading of the lungs or spasm of the glottis. In some cases a body

¹ Mr. Hulke recommends especially a hook made out of a long piece of stout German-silver wire.—‘*Med.-Chir. Trans.*’ vol. lx. p. 91.

² Liston succeeded in extracting a piece of bone from a point below the right sternoclavicular joint with forceps ; and Dickin, of Middleton, near Manchester, extracted a button which had lodged in and completely obstructed the right bronchus, producing the most characteristic signs of total suppression of breathing on the right side. The latter case is the more remarkable, since the opening was made between the cricoid and thyroid cartilages, and therefore the wound was farther than necessary from the foreign body (see South’s ‘*Chelius*,’ vol. ii. p. 402, or Liston’s ‘*Practical Surgery*,’ pp. 415-420).

³ ‘*American Clinical Lectures*,’ vol. ii. p. 199. Putnam, New York, 1876.

⁴ Sir T. Watson used to relate a case in which a piece of gold remained for years in one of the ventricles of the larynx without distressing consequences ; and there are other cases recorded in which a foreign body has become glued to the wall of the trachea, or has ulcerated into its substance and thus become encysted.

which has long lain quiet changes its position, irritates the vocal cords, and so produces spasm of the glottis. In many cases in which a smooth body has been lodged in the deeper parts of the tube it has ulcerated into the lungs and produced all the symptoms of phthisis; ¹ so that Sir B. Brodie says: 'The records of surgery furnish abundant evidence that under such circumstances, disease of the lungs sooner or later is induced, and that the death of the patient invariably ensues.' And even when the body is lodged higher up, in the larynx or upper part of the trachea, there is good reason to apprehend that it will set up ulceration at the seat of its lodgment, and that disease of the lungs will follow. This is strikingly illustrated by a case reported by South (op. cit. p. 396), in which a child died six weeks after the lodgment of a pebble in the larynx. The nature of the case was mistaken, and the severe paroxysms of cough attributed to pertussis. The cricoid cartilage in which the stone was lodged was laid bare by ulceration, and both lungs were extensively hepatised, while one pleura was filled with turbid serum.

The implication of the larynx in a burn or scald is a very grievous and dangerous complication of such an injury, and one which unluckily is by no means rare. The parts below the glottis are protected by the spasmodic closure of the vocal cords at the moment of the accident, but great œdema of the mucous lining of the fauces, epiglottis, and orifice of the larynx comes on, with fits of spasmodic dyspnœa, which are always exceedingly alarming and not unfrequently fatal; the voice is hoarse, the respiration croupy, and the mouth probably so much injured that the patient (especially if a child) can hardly be got to take food. The accident is more frequent in childhood, and is often caused in very young children by sucking the spout of the kettle. The great danger is from the spasms, and the prognosis depends mainly on their severity and frequency; but even after surviving this danger the patient may still sink from bronchitis or broncho-pneumonia, the result of inflammation spreading downwards.

Burn and
scald of the
larynx.

In such cases the first point is that the patient must never be left until all immediate danger is over, since the spasms come on quite irregularly and with little warning.² Leeches should be freely applied to the throat, and frequent small doses of calomel and antimony, or antimony and aconite, given. The dose must of course vary in proportion to the age. Mr. Durham prescribes one or two minims of vin. ant. with a quarter or half minim of tinct. aconit., at first every quarter of an hour, then every half-hour, and then at longer intervals. Possibly the cautious administration of chloroform will relieve the spasms, and then the mouth can be fully opened and the œdematous parts around the fauces freely scarified. Finally, in the last resort, laryngotomy or tracheotomy must be performed; but my experience of these cases has been that those which are so severe as to demand operation generally die, and that it is better if possible to refrain from opening the wind-pipe, remembering that even very alarming spasm seldom proves fatal.³ Some surgeons prefer

¹ Characteristic cases, which want of space forbids me to introduce, will be found in South's 'Chelius,' vol. ii. p. 397.

² Mr. Bryant speaks of a case 'in which the symptoms were so slight that no anxiety was felt; but one spasm took place 2½ hours after the accident, which put an end to life.' ('Practice of Surgery,' 2nd ed. vol. ii. p. 24.) This is a striking instance of the necessity of constant watchfulness and preparation for instant operation in these as in all other cases in which spasm of the glottis appears imminent.

³ I would refer the reader to a striking case related by Mr. Le Gros Clark (op. cit. p. 230), in which the symptoms were so acute that, 'though not entertaining a favourable

the operation of tracheotomy to that of laryngotomy in these cases, in order to get farther from the injured parts ; but as the œdema is always limited to the tissue above the vocal cords, the operation of laryngotomy is sufficient. In very early life, however, the size of the cricothyroid space is not sufficient to allow a free opening, and then laryngo-tracheotomy must be performed. Much benefit is obtained in the treatment of the broncho-pneumonia which accompanies these and other injuries of the windpipe from the use of the 'jacket-poultice.'

Cases occur in which the larynx is injured by corrosive fluids ; these must be treated on the same principles.

The operative procedures for opening various parts of the air-passage, and the indications for each of them, will be found in a future chapter, under the head of DISEASES OF THE LARYNX.

Foreign
bodies in
the œso-
phagus.

Nothing is more common than for a patient to imagine that he (or she) has got some foreign substance lodged in the pharynx or œsophagus, when no such thing is really the case. Something sharp has been swallowed with the food, such as a sharp edge of bone, and the sensation of the scratch remains after the substance itself has passed away, and, indeed, may remain for a considerable time, rendering deglutition painful and difficult. At the same time cases occur pretty frequently in which a pin or a small bone or bristle has been hidden behind the arches of the fauces and has escaped a hasty examination ; so that all such cases should be patiently and completely investigated, and in doubtful cases the laryngoscope will be very useful, though the examination can of course only extend to the fauces and upper part of the pharynx.¹ Large foreign bodies are generally arrested in the œsophagus opposite the cricoid cartilage, but they may pass lower. I have spoken above of those cases in which a voluminous mass rests above the pharyngeal opening of the larynx, and must be displaced, or instant death results. But in cases of foreign bodies lodged in the œsophagus there is no such urgent danger. The impaction, however, of a solid body is inconsistent with prolonged life, since it prevents deglutition either by mechanically filling the gullet, or by the pain which it produces when it sticks into the walls of the tube, as a pin or a sharp bone sometimes does. The nature, size, and shape of these foreign bodies are very various. A toothplate carrying one or two artificial teeth not unfrequently drops into the mouth and is swallowed during sleep ; a coin swallowed intentionally ; a ragged piece of bone ; a pin or piece of wire or a fish-bone, are similar instances. Some obstruct the gullet entirely, others partially ; some are organic and soluble, others metallic and insoluble : some have smooth edges, others are jagged or sharp. The first point is to ascertain as nearly as may be what the size and shape of the substance is and where it is lodged, in order to settle the important question whether it can be pushed down into the stomach or fished up from the mouth. A smooth metallic body deeply lodged is best dealt with by gently pushing it down into

opinion of tracheotomy,' he thought it his duty to offer the alternative to the child's parents, who, however, declined the operation ; and the patient ultimately struggled through. Mr. Le Gros Clark's remarks on the advisability of avoiding tracheotomy as much as possible quite coincide with the view stated in the text.

¹ A very interesting case is recorded by Dr. Fruitnight of New York in the 'N. Y. Arch. of Clin. Surg.' vol. i. p. 335, where a pin, which had been impacted for three weeks in the posterior nares, and was giving the patient great inconvenience, was detected and removed by means of the laryngoscope.

the stomach with a probang having a sponge at the end ; and even somewhat rough bodies may be successfully treated this way, though the practice is not without its dangers.¹ If more superficially lodged it may possibly be extracted with the long œsophagus-forceps, which must, however, be very gently managed, in order to avoid injury to the coats of the œsophagus. Coins can often be dislodged and fished up by a blunt hook at the end of a probang. The situation of the coin having been ascertained by means of a long probe or a urethra-sound, the hook is pushed beyond it, and turned round towards the coin, and withdrawn. Pins, small bones, &c., may be caught in the horsehair probang here figured.

Pieces of meat and bone have been known to be so far disorganised and softened by the constant use of dilute mineral acid as to be at length swallowed. Vomiting has sometimes been successful in dislodging foreign substances. It is dangerous to the integrity of the œsophagus ; but when a large and tolerably smooth foreign body is lying in the stomach and cannot pass the

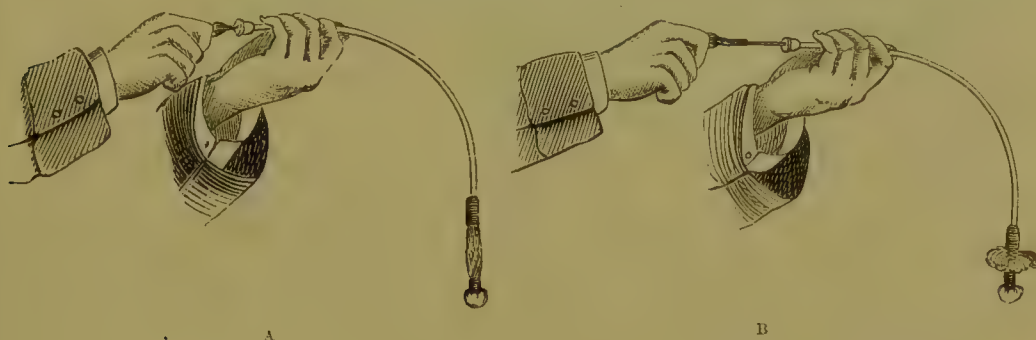


FIG. 68. The horsehair probang for extracting foreign bodies from the œsophagus, such as coins, bones, &c., which are lodged in, but do not entirely obstruct, the tube. The instrument contains a skein of horsehair inserted near its extremity, which is dilated by pulling its handle out. It is introduced, as seen in fig. A, with the skein closed, past the foreign substance. Then the handle is pulled out (fig. B) and the instrument withdrawn with the skein opened, in order that the horsehair may catch and bring away, or at least dislodge, the foreign body.

pylorus, it is probably best, as Mr. Pollock directs, to attempt its removal by inducing vomiting after a full meal, so that the foreign substance may be rejected along with the mass of food.

Finally, there remain a few cases where the surgeon thinks it his duty to cut down on the foreign body and remove it at once. œsophago-

This operation is most easily performed on the left side, in consequence of the inclination of the œsophagus to that side, but the shape of the substance may render it necessary to cut down from the right. It consists essentially in making an incision between the carotid sheath and the larynx or trachea, drawing the latter tube inwards, while the vessels are displaced outwards, and seeking for the foreign substance through the wall of the œsophagus, which is now exposed. The incision and the early steps of the operation are much the same as for ligature of the carotid. The centre of the incision should be about opposite the cricoid cartilage. If it be too high the superior-laryngeal nerve will be endangered ; if too low, the inferior thyroid

¹ Mr. Pollock, in the 'Lancet,' 1869, vol. i. pp. 456-490, records two cases in which a toothplate slipped into the œsophagus. In one, where the plate was small, carrying only two teeth, but with very sharp edges, the patient seemed to be in danger of sinking from want of food, the plate being lodged near the stomach, whence it was somewhat dislodged by means of an œsophagus-tube, and then it passed into the stomach, on the nineteenth day after the accident. Here it remained for ninety-seven days, and was then ejected by vomiting. In the other case a much larger plate, but with much smoother edges, passed through the whole alimentary canal, and was expelled in defæcation in three days.

artery. When the foreign body is too small to be perceptible externally, its situation and the position of the œsophagus are to be fixed by passing a staff or catheter down the tube. When the surgeon has felt the foreign body he divides the œsophagus longitudinally, just enough to enable him to catch it and draw it into the wound; it must then be freed from the fibres of the œsophagus as gently and with as small an opening as possible. Sutures have hitherto been seldom used to close the wound in the œsophagus, but it seems probable that one or two fine catgut sutures may hasten its closure, when the wound is not lacerated, and melt without producing any ulceration.¹

Some surgeons feed the patient by the rectum for a few days after the operation, but Mr. Cock thinks it better to pass a small tube or elastic catheter beyond the wound, and let the patient have food in the stomach from a very early period after the opening. A tube having a tunnel-shaped end may be passed at the time of the operation and retained for a few days.²

Foreign bodies have been extracted from a part of the œsophagus much lower than can be reached by the incision. Thus Mr. Syme removed a foreign body lodged just opposite the top of the sternum, and Dr. Cheever one which was fixed below the sternum.³

The operation has hitherto proved very successful. Forty-five cases are referred to in Mr. Durham's essay on injuries of the neck in the third edition of the 'System of Surgery,' of which only nine proved fatal; and it seems undeniable that in some, at any rate, of these latter, a more speedy performance of the operation would have given the patient a better chance; for in one case (Arnott's), where the operation was not allowed until five weeks after the accident, the patient died of pneumonia, which had been developed previously; in four cases abscess had already formed; and in another (Martini's), where sixty attempts have been made to dislodge the foreign body (which was, in fact, swallowed during the operation), the pharynx was found to be gangrenous. Hence the propriety of the rule laid down by Mr. Arnott⁴ is now generally recognised: that 'when a solid substance, though only of moderate size and irregular shape, has become fixed at the commencement of the œsophagus or low down in the pharynx, and has resisted a fair trial for its extraction or displacement, its removal should *at once* be effected by incision, although no urgent symptoms may be present.'

In several cases, where the foreign body has not produced complete inability to swallow, it has nevertheless occasioned death by ulceration into the aorta, the spinal column, pleura, or the carotid artery (usually the left), or some other large vessel, or even the heart.⁵

Injuries to the œsophagus by the passage of foreign bodies, or by swallowing corrosive liquids, will sometimes produce a severe form of cicatricial stricture; but on this subject, and on the subject of gastrotomy, or opening the stomach in order to remove a foreign body, or to obviate starvation in

¹ See Lediard, 'Clin. Soc. Trans.' vol. xviii. p. 298.

² See Lawson, 'Clin. Soc. Trans.' vol. xviii. p. 296.

³ Cheever 'On two cases of (Esophagotomy.' Boston, U.S., 1868.

⁴ His interesting paper in the eighteenth volume of the 'Med.-Chir. Trans.' relating to the first case of œsophagotomy performed in this country, is well worthy of study.

⁵ See Durham, in 'Syst. of Surg.' 3rd ed. vol. i. p. 787; and Rivington, 'Med.-Chir. Trans.' vol. lxi. p. 63, on a case of ligature of the left common carotid, wounded by a fish-bone, which had penetrated the pharynx. Here all the cases are collected in which blood-vessels have been penetrated by foreign bodies from the pharynx. Mr. Rivington believes that this frequently results from the incautious use of a probang.

stricture of the œsophagus, I must refer the reader to a future chapter in which the latter subject is treated.

In a case of stricture of the œsophagus from epithelioma, limited to the parts around the thyroid cartilage and thyroid body, I performed the operation of œsophagostomy,¹ i.e. made a permanent opening in the œsophagus, and introduced a tube through which food could be passed into the stomach. The operation did no good, as the patient, who was much exhausted, sank in three days; but it was equally harmless. It proved, however, one of considerable difficulty. Further experience is needed to show whether this operation is ever preferable to gastrostomy, and, if so, in what cases it should be used.

Œsophago-
stomy.

The subject will be resumed in speaking of stricture of the œsophagus.

¹ 'Med. Times and Gaz.' July 29, 1882.

CHAPTER XI.

INJURIES OF THE CHEST.

IN describing the injuries of the chest, the pleura is always taken as the boundary between its parietes and its contents, so that wounds are classified as penetrating or non-penetrating, according as they do, or do not, open the pleural cavity. At the same time it must be recollected that the pleura, or any of the thoracic viscera or vessels, or even the viscera of the abdomen, may be injured in contusions and in non-penetrating wounds by fragments of fractured ribs, and also that (though in very rare cases) the lungs or heart may be lacerated in contusions not involving any fracture of the ribs.

Contusions
and flesh
wounds.

Rupture of
muscles.

There is little that is peculiar to the region of the body in contusions or flesh-wounds of the chest. It may, however, be worth mention that the pectoral muscle is sometimes ruptured in severe sprains or other injuries in which the patient's arm is violently jerked while his body is in rapid motion in the other direction (as when in a fall a man grasps at a bar). The injury may be known at once, by the great gap which is found in the front wall of the axilla, and the loss of the functions of the muscle. Sometimes also large extravasations or blood-tumours are formed under the pectoral muscle, which can only be distinguished from subpectoral abscess by their rapid formation, and the absence of any inflammatory symptoms or appearances.

The treatment, however, of these complications differs in no respect from that of ruptured muscle, or of hæmatoma, in other parts of the body.

Sub-pecto-
ral abscess.

Abscess beneath the pectoral muscle is met with as the result of injury, and also forms spontaneously. The main point is to diagnose it from deep-seated hæmatoma and from rapidly forming cancer. The œdematous infiltration and inflammation of the surrounding cellular tissue, and the clearness of the fluctuation, are the main features which distinguish it from both, and in case of need the grooved needle will settle the question. A free and deep incision is necessary, and this is best made under anæsthesia, especially as large vessels may be divided. It is usually recommended to make the incision across the fibres of the muscle, a recommendation from which I venture to dissent. Quite as satisfactory exit for the matter may be procured by an incision running between the fibres, provided it be free enough, for which purpose, when the matter is reached, the incision may be dilated with the finger. The cavity must be thoroughly syringed out with some antiseptic lotion, and a large drainage-tube inserted.

Fracture of
the ribs.

Fracture of the ribs is a very common accident, and occurs either as the result of direct violence, in which case usually only one or two ribs are broken, or of indirect force from compression of the thorax by a crush either from the back or front, when a good many ribs give way at or near their angles, and sometimes on both sides of the chest. A rib may also be fractured by muscular action in coughing—an occurrence which is somewhat ominous of the presence of disease in the fractured rib, but has been known to occur without any evidence of such disease. The broken ends of the ribs may be driven into the pleura, the lung, the diaphragm, and even through the diaphragm into the liver or spleen; but the last-named lesions are very rare, and

are usually only found in extensive and necessarily fatal injuries. It will be sufficient for practical purposes to discuss merely fractures of the ribs ; (1) uncomplicated, and (2) complicated with injury to the lung.

Simple uncomplicated fracture of one or two ribs is a very trivial accident, hardly ever followed by any grave consequences if properly treated. But the danger increases considerably when many ribs are broken, and particularly on both sides. I have seen, however, a young woman recover from an accident in which, as far as could be ascertained, every rib in the body was broken and extensive injury inflicted on the brachial plexus of one side. The first and (though to a less extent) the second ribs are not so liable to fracture as those below them, the projection of the clavicle and the mass of the pectoral muscle shielding them from injury ; and the floating ribs by their extreme mobility also more commonly escape fracture. Fracture of the upper ribs is looked upon as a more serious injury than of the lower, since the lung is more often wounded. The posterior part of the ribs is less exposed to fracture than the middle, being under the protection of the thick muscles of the spine. The ribs do, however, give way sometimes near their tubercles, and the injury is difficult of diagnosis ; sometimes discovered after death in cases where it has not been possible to form a distinct diagnosis during life. The signs of fracture of the ribs are pain at the part, aggravated by deep breathing or coughing, and crepitus. The breathing is often very shallow, and there is short hacking cough.¹ It is not by any means always easy to detect the crepitus of a fractured rib. The periosteum is often untorn,² and then it is difficult to produce sufficient movement of the fragments on each other, or they may perhaps be interlocked, though we can hardly conceive them to be absolutely impacted. At any rate, it is certain that in many cases where we have every reason to believe fracture to have occurred it is not possible to elicit crepitus. The best plan is to lay the hand flat on the suspected part and get the patient to breathe deeply or cough, if it does not give too much pain. If this does not succeed, each rib may be traced, and manipulated at either side of the supposed fracture like any other bone, care being taken not to handle portions of two different ribs, as unskilful or careless persons sometimes do. Auscultation is recommended, but I cannot say that it seems to me of any use. I have heard the crepitus of an undoubted fracture through the stethoscope, but never succeeded in thus hearing a crepitus that I could not feel. It is, however, only right to add that other surgeons have a higher opinion of the diagnostic value of auscultation.³

The union of fractures of the ribs takes place, it is said, in about thirty to thirty-five days, but I believe that this is very variable, and that the time required for union is often much longer. I have felt crepitus a fortnight after the injury as fresh and distinct as at the time of its infliction. And the impossibility of keeping the fragments at rest causes fractures of the rib to unite by provisional callus more frequently than those of any other

¹ Mr. Le Gros Clark conjectures that these symptoms are sometimes the result of injury to or pressure on the intercostal nerve by the broken bone.

² M. Coulon cites, in his '*Traité des Fractures chez les Enfants*,' p. 90, a case published in the '*Bull. de la Soc. de Chir.*' 2nde sér. tom. i. p. 675, of a child who died of rupture of the lung, and in whom incomplete fractures of two or three ribs were found on both sides. This author believes incomplete fracture of the ribs to be very common in childhood.

³ See Lyell, in '*Syst. of Surg.*' 3rd ed. vol. i. p. 808.

bone in the human subject. In fact, excluding some very exceptional cases (like that represented in fig. 34), all the instances of regular ensheathing callus in the human subject are taken from fractures of the ribs (see fig. 33, p. 131). In some cases the adjacent ribs when broken become fused together, as in a specimen figured in the 'System of Surgery,' 3rd ed. vol. i. p. 809, and others in Hamilton's work.

The treatment consists in avoiding the movements of respiration as much as is compatible with the patient's comfort. Confinement to bed is necessary only in the severer cases, but all active exertion should be forbidden. A bandage to the chest usually affords great relief. It should be applied around the whole thorax, as low as the end of the sternum, and should be commenced when the patient has emptied the chest as much as possible; the roller should be six inches broad, and should be adapted to the varying size of the chest by reverses where necessary. When the bandage is finished a piece long enough to go across the chest should be left hanging, being secured by a pin or tacking; this should be split half-way down and the two ends brought over the shoulders and fastened on the other side like a pair of braces, in order to keep the bandage from slipping down; or a piece of this kind should be sewn on. Another plan is to fix the injured side only of the chest by broad pieces of strapping applied from the spine to the sternum. This is thought to embarrass the breathing less, as it does not interfere with the movements of the sound side of the chest. Sometimes a mere belt is applied round the injured part fixed with buckles.

The bandage is to be worn till the patient can dispense with it with comfort, say for a month. When any noticeable displacement is felt, in consequence of one end lying below the other, an attempt may be made to repress it by placing a pad on the projecting part of the rib which is driven in, so as to prise outwards its buried end.

Fracture
with wound
of lung.

When the lung is injured the complication is at once marked by the resulting emphysema. The fractured end of the rib or ribs must be driven through the pleural cavity into the lung, an occurrence much more likely to take place in fracture from direct violence, when the bone is driven directly downwards, than in that from indirect force, when (the curve of the bones being increased) the tendency is for the ends to spring outwards.¹ It is, occasionally, complicated with air in the pleural cavity, the elevation of the ribs in inspiration drawing the air into this cavity, whence the descent of the ribs in expiration forces it into the wound which the broken rib has caused in the parietal pleura and thence into the subcutaneous tissue. But in many cases, especially in young people, there is no pneumothorax. The wound in the lung becomes opposed to the wound in the pleura, and during expiration the air is expelled directly from the lung, through the rent in the pleura, into the subcutaneous tissue. The sensation of emphysema is so peculiar that when once recognised it can never afterwards be mistaken. It is a dry crackling sensation, perceptible on the very slightest touch, quite unlike any other phenomenon presented either in health or disease: and in

Emphy-
sema.

¹ Prof. Bennett throws doubts on this, which is the usual opinion as to the ordinary displacement of the ribs in fractures by direct and indirect violence. From his researches it would appear that in the latter case also the fragments are usually displaced inwards (see 'Syst. of Surg.' 3rd ed. vol. i. p. 807, or 'Dublin Quarterly Journal,' March 1876). This may be so, and yet it may remain true that *considerable* inward displacement is more likely to accompany direct than indirect violence: and certainly the preparations which I have seen of outward displacement have been, as far as I can recollect, from indirect force. A striking example is in the Museum of St. George's Hospital.

cases of injury to the chest there is hardly any other source from which it can come except a wound of the lung.¹ At the same time it should be remembered that a small quantity of air may be forced into any punctured or lacerated wound. I have seen it in a wound of the leg, and once I saw a case in which emphysema existed to a slight extent over the back of the chest, and it had been hastily concluded that the ribs had been fractured, the only injury being a spike-wound at the back of the scapula. Such mistakes, however, must be very uncommon, and very little care is necessary to avoid them. When fracture of the ribs is complicated with a wound of the lung, the injury is, of course, much more serious than when no such complication exists. At the same time the lung is so prone to rapid union that if the injury be only slight the prognosis is not unfavourable. The first question is, whether or no to bandage the chest. Great surgical authority may be quoted on both sides. The fragments have certainly been displaced inwards, and, if this displacement be reproduced by bandaging, it may perpetuate an irritation which is very important to stop at once. On the other hand, the movements of the chest may also produce irritation around the fractured ends, and so in the wounded portion of the lung.² The patient's feelings are the best guide. If the steady pressure of the hand on the seat of fracture is grateful to him, it is well to try the effect of a bandage, which, however, must be removed at once if it increases the dyspnœa or causes pain. Bandaging is certainly contra-indicated when there is much comminution or tearing of the parietes of the chest, as happens sometimes in such accidents as a blow from a carriage-pole, where a large rent may be seen in the chest-walls, into which the air bulges in the form of a large bladder under the skin with each expiration. Besides these local measures, the treatment of fractured ribs with wound of the lung consists in perfect repose, with low diet (unless the patient be very weak at the time), until all fear of inflammation has passed over. The occurrence of inflammation will be proved more by the general symptoms of feverishness and dyspnœa, with rusty-coloured sputa and hacking cough, than by any physical signs, since the condition of the part often forbids percussion or auscultation. When this is not the case the use of the stethoscope is imperative. When inflammation is clearly marked nothing affords so much relief as bleeding, especially if done early. Venæsection is of course inadmissible if the pulse is very weak, but when there is much dyspnœa and a strong, hard pulse, the relief given by the abstraction of a moderate quantity (as 10 or 12 oz.) of blood on the first accession of the symptoms is often decisive. Antimony in moderate doses (say $\frac{1}{10}$ to $\frac{1}{8}$ of a grain every four hours) may also be given to robust patients; and if the symptoms call for it the bleeding may be repeated. In the weakly or in conditions of much depression a jacket-poultice should be applied, small doses of morphia combined with squills or some

¹ In an open wound of the pleura without wound of the lung emphysema may occur, though it rarely does (see GUNSHOT WOUNDS), and emphysema may also occur in stabs implicating one of the large bronchi, and in rupture of the lung without fracture of wound. Emphysema also occurs in cases of fracture of the cartilages of the larynx, and may travel from the neck down on to the surface of the thorax. Spontaneous emphysema from rupture of a vomica, or even from rupture of the healthy lung in violent efforts, such as those of parturition, is a rare and curious affection.

² I am certainly opposed to bandaging or strapping if there is much emphysema. The compression of the chest-wall prevents the escape of the air into the subcutaneous tissue, where it does little or no harm, and has a tendency to cause it to collect in the pleural cavity, and thus cause compression of the lung.

demulcent mixture ordered, and it may even be necessary to administer a little wine cautiously.

Complica-
tions of
fractured
ribs. Em-
physema.

The emphysema in itself is usually of no consequence whatever. Cases are on record in which the cellular tissue has been said to be so blown up with air as to produce a real embarrassment to the patient's breathing, and to require evacuation by scarifications, but I have never met with anything of the sort. If necessary, however, any quantity of air might easily be let out through an exploring trocar introduced in a few convenient places. The air generally disappears of itself, being probably taken up by the fluids of the part.¹

Pneumo-
thorax.

The other complications of fractured ribs are very numerous. Air, blood, serum, or pus, or a mixture of several of these fluids, may be effused into the pleural cavity. Pneumothorax may be present to an extent sufficient to cause embarrassment to the breathing, particularly if the wound in the parietal pleura has become closed, and in such circumstances the pneumothorax requires treatment. Besides dyspnœa, there will be unnatural resonance to percussion in parts away from the injury, flattening or convexity replacing the natural concavity of the intercostal spaces, increase in the circumference of that side of the chest, and loss of respiratory murmur. If the quantity effused be so great as to impede respiration, the air must be drawn off by a trocar or exhausting-syringe, and this must be repeated as often as necessary; but, as Mr. Le Gros Clark has pointed out, it hardly ever is necessary, since when the air is in quantity sufficient to press on the lung that very pressure opposes further extravasation of air.

Hæmo-
thorax.

Hæmothorax, again, may occur from wound of an intercostal artery or of some large vessel or vessels in the lung. Along with the dyspnœa there is in well-marked cases much collapse or complete syncope, with other symptoms of internal hæmorrhage. The physical symptoms are those of fluid in the pleura (dulness on percussion, bulging of the intercostal spaces, loss of respiratory murmur), and often metallic tinkling or splashing from the admixture of air with the fluid, and combined with these often a dark colour under the skin of the loins, as if from sugillation of the blood through the pleura into the intermuscular spaces. If the patient seems to be really likely to die from the mere pressure of the blood, it is doubtless necessary to draw off the fluid part with the aspirator; or if this does not give the required relief, to make an incision and evacuate the semi-coagulated mass; but such measures are hardly ever required, and are deprecated by many good surgeons as interfering with the closure of the wound in the artery, which is favoured by the pressure of the clot.

The occurrence of hydrothorax or empyema as the result of pleurisy after an injury is marked by the same symptoms, and requires the same treatment as when such conditions occur under other circumstances, for which I must refer to works on medicine.

The other complications are much more rare, viz. lesion of the pericardium and heart, injury to the intercostal arteries, wounds of the diaphragm, causing laceration of the abdominal viscera. As all these injuries are much more common from other causes than from fracture of the ribs, they are best treated of separately.

Fractures of the ribs are not unfrequently compound, i.e. the ribs are often fractured in gunshot and other wounds of the chest, but the fracture

¹ An interesting discussion on the mode of removal of the extravasated air will be found in Mr. Le Gros Clark's work, p. 204.

of the rib is in these cases only a subordinate part of a much graver injury, which usually involves the lungs, heart, or great vessels. The general features of such injuries will best be understood from the remarks on GUNSHOT WOUNDS in a subsequent chapter, and from those which follow presently, on PENETRATING WOUNDS OF THE CHEST.

The costal cartilages may be fractured, although I am not aware that the injury can be accurately diagnosed unless one fragment overlaps the other, which does occasionally happen. Delpach is quoted by Mr. Poland as saying: 'If the fracture takes place near the sternum the internal fragment passes in front and crosses the external; the contrary when the fracture is nearest the rib.'¹ In such cases it seems difficult to get the fragments into their proper position; and as no serious inconvenience results from the displacement it is unwise to use any severe measures for that purpose. If the fragments can be manipulated into position, a bandage should be applied to keep them so. If not, I should be disposed to leave them to unite as they are. Malgaigne speaks favourably of the use of a kind of truss. The injury is usually repaired by bone, sometimes by a mixture of bone and cartilage. (See page 140.)

Fracture
of costal
cartilages.

Fracture of the sternum rarely occurs as a separate injury, but it is not very uncommon as a complication of fracture of the spine, and it sometimes, though rarely, accompanies fracture of the ribs. The rarity of fracture in a bone so exposed to violence as the sternum testifies to the efficiency of the protection afforded to it by the costal cartilages, which support it exactly like so many elastic springs. The sternum, however, is sometimes fractured by direct violence, by indirect force (as in fracture of the spine), and even by muscular action.² Some surgeons seem to believe that a frequent cause of fracture of the sternum is the forcible impact of the chin against the top of the bone in a violent bend of the neck. The fracture occurs generally in the upper half of the gladiolus, or near the junction of the first and second pieces of the bone, and what is called a fracture is often, as Mr. Rivington³ has shown, a true dislocation, there being a regular diarthrodial joint in this situation. The symptoms somewhat resemble those of fracture of a rib, and there is not generally much difficulty in detecting it by manipulation even when there is no displacement, but very commonly the upper fragment is found behind the lower, leaving no doubt of the nature of the case. In fracture involving only the sternum there are rarely any visceral complications.

Fracture
of the
sternum.

The treatment is much the same as for fracture of the ribs; the displacement often remains permanent, but no evil consequences need be feared from it, nor is the accident in itself a formidable one. Longitudinal fissures in the sternum have been dissected in the dead body, and more rarely recognised in the living by the displacement of the fracture.

Dislocation of the head of the rib from the spinal column, or of its extremity from the sternum, or from the cartilage, can hardly be spoken of as a separate surgical injury, since it is usually only a subordinate part of the case, and in any event its treatment would be exactly the same as that of

Dislocation
of the ribs.

¹ 'Syst. of Surg.' 3rd ed. vol. i. p. 810.

² Lyell, in 'Syst. of Surg.' 3rd ed. vol. i. p. 812.

³ 'Med.-Chir. Trans.' vol. lvii. p. 101.

fractured rib. In Mr. Lyell and Mr. Poland's article in the 'System of Surgery' the reader will find references to the recorded cases of this rare injury.

Penetrating wounds. Diagnosis between wound of the lung and wound of the pleura only.

Penetrating wounds are such as either open the pleural cavity only, or pass more deeply, wounding the lungs, heart, or great vessels. There are no absolute signs by which a wound of the pleura only can be distinguished from one of the lung, since the passage of air out of the wound (traumatopnœa) is noticed in wounds which terminate in the pleural cavity. As the parietes of the chest rise up in inspiration the air finds its way through the wound into the pleural cavity, whence it is expelled into the cellular tissue (emphysema), or through the wound (traumatopnœa) in expiration.¹ However, when the lung is also wounded the expelled air is usually churned up with the blood in the lung into a fine bloody froth, the absence of which sign in a penetrating wound encourages the hope that the pleura only is wounded. Exploration with the finger or probe is only permissible when there is good reason for suspecting that a foreign body is lodged in the wound. Hæmoptysis may be present to a certain extent when the lung is not wounded, and, on the other hand, it may be (though it rarely is) absent when the weapon has passed into the lung. These remarks apply, however, of course rather to small punctures than to free wounds of the lung, the nature of which is usually obvious enough. In the graver cases of wound of the lung much air and blood will be effused into the pleura, and blood will also be extravasated into the tissue of the lung itself, so that the patient is menaced with death both from apnœa, the result of pressure on the lung, and syncope, caused by loss of blood and shock. The chief danger in wound of the lung, according to Mr. Le Gros Clark, is in the early loss of blood: 'if this peril be survived, the risk of fatal inflammation would appear to be less under favouring conditions than might be anticipated' (op. cit. p. 217).

All penetrating incised wounds of the chest, if small; should be closed at once, and dressed antiseptically. The temperature of the patient must be carefully watched, and the chest examined daily for effusion. Should this occur, a small quantity of the fluid must be withdrawn with an exploring trocar, and, if it is turbid, the wound should be opened up at once and a drainage-tube inserted. If the wound is large and the lung evidently extensively injured, it is a better plan not to completely close the external wound, but to insert a large drainage-tube, to carry off the effused blood into the antiseptic dressing and so prevent its accumulating in the pleural cavity. The collapse should not be interfered with at first, unless it be so severe that it threatens to prove fatal. The patient should be kept perfectly quiet and very cool. In fact, the object of the surgeon should be to avert hæmorrhage. In reaction, as the pulse rises bleeding may be indicated, and

¹ Nélaton gives four conditions under which emphysema may occur: 1. In a wound of the lung with external wound. The air passes during inspiration into the pleural cavity from the open air-cells and from the outer air through the wound, and in expiration is pressed out through the wound or into the cellular tissue. 2. In a wound penetrating the parietal pleura but not the visceral, if there is any impediment to the free passage of the air out again through the wound. 3. In wound of the lung without external wound, as in fracture of the ribs. 4. In rupture of the lung without injury to the visceral pleura the air may be extravasated between the lobules of the lung, causing emphysema at the root of the lung, which extends into the lower part of the neck. In rupture of the lung without injury to the parietal pleura pneumothorax will occur, but no emphysema. (Nélaton 'Path. Chir.' vol. iii. p. 447.)

afterwards, when inflammation threatens or has commenced, the treatment already described must be pursued (p. 211).

Wounds of the lung under favourable circumstances, as in healthy persons, unite rapidly, and the prognosis is by no means desperate.

Pneumocoele, or the protrusion of a portion of the lung through the wound, takes place either immediately on the accident (primary), or after an interval (consecutive). Hernia of the lung.

Primary hernia of the lung, when the protruding lung is exposed by a wound, forms a globular mass, varying in size from a marble to a cricket-ball. Its dark colour, shining surface, and crepitating feel sufficiently indicate its nature, and distinguish it from a protrusion of the omentum which has sometimes been observed in the lower intercostal spaces. If recent, and if it can be reduced without violence, this should be done, the tissues of the wound which constrict the neck of the protrusion being, if necessary, divided, in order to allow of the easy return of the lung into the thoracic cavity, when the wound is to be united. But if some time have elapsed, and the lung be altered in structure, no attempt at reduction should be made, nor is any other mechanical interference permissible—the herniated lung must be allowed to slough off. Some surgeons think it better to tie a ligature round the herniated portion, which may afterwards be removed if it be thought advisable, when the protruded part has contracted adhesions to the parietes.¹

Primary hernia of the lung takes place also beneath the skin in cases of extensive fracture of the parietes of the chest accompanied by free laceration of the soft parts. In such cases it is useful to repress the protrusion by a carefully applied pad.

Consecutive hernia takes place after the wound has cicatrised, so that the lung is covered by skin or cicatrix. It forms a globular, elastic tumour, which falls in during inspiration, disappears in holding the breath, and swells in expiration, and particularly in coughing. On manipulation it crepitates, and auscultation detects a harsh-toned vesicular murmur.

Nothing can be done beyond protecting it, if it seems necessary, from any accidental injury by adjusting a concave shield over it. This will also obviate any chance of the increase of the protrusion.

Foreign bodies which are lodged in a wound of the chest must be extracted at once, and many histories testify to the possibility of recovery even after complete perforation of the thorax by a very voluminous foreign body, as in the celebrated preparation in the College of Surgeons' Museum, from a man who lived ten years after having a gig-shaft run through his chest from one side to the other. And life is not incompatible even with the permanent lodgment of a foreign body, as in Velpeau's case of a man who lived fifteen years with part of a fencing-foil in his chest, which had entirely traversed the thorax, the point being implanted in the spine, the broken end fixed in one of the ribs, and the weapon itself buried in the lung, where it was surrounded by calcareous deposit.² But such exceptional cases as this do not invalidate the general rule that foreign bodies should be removed at once whenever it can be done without too great risk. Sometimes the foreign body (usually a bullet) drops into the pleura, and thus may entirely escape

Foreign
bodies
lodged in
the thorax.

¹ See a case very clearly and succinctly described in 'Med.-Chir. Trans.' vol. xx. p. 378, by Mr. Forde.

² 'Syst. of Surg.' 3rd ed. vol. i. p. 836.

detection, though in some such cases the substance has been found by a probe, and has been extracted either by a pair of forceps or by direct incision. If the foreign body be left in the pleura it will probably produce death by pleurisy and empyema, though it is certainly not impossible that it might become encysted.

Wounds of
the medias-
tinum, pe-
ricardium,
and heart.

In some cases weapons have penetrated the mediastinum without wounding any important parts, and in still rarer cases the pericardium has been wounded, and yet the heart has escaped injury ;¹ but no diagnosis can, I think, be made between the latter injury and that in which the heart is also wounded.

The symptoms of wound of the heart are chiefly those of acute internal hæmorrhage, which usually proves rapidly fatal. There is a peculiar tremor about the heart, with intermittent small pulse ; and there is also a peculiar undulating crepitation and bruit accompanying the heart's action, and due to the blood effused around it into the sac of the pericardium. The position of the wound, and the severe symptoms which accompany it, are the only tests of the reality of the injury to the heart itself.

Death is the ordinary but not, as it seems, the inevitable consequence of wound of the heart. The wound usually proves fatal by hæmorrhage into the pericardium, the blood collecting about the heart and impeding its motion ; or in case of a free opening into one of the cavities the mechanism of the heart may be destroyed, the blood passing so freely out of the heart that its pumping action is suspended.² A wound of the heart may also prove fatal at once by the 'shock' to the heart, or subsequently by pericarditis, or from some of the many complications of penetrating wounds of the thorax. But there seems no question that in man and other warm-blooded animals wounds of the heart do not always prove fatal. Animals have been dissected in whom foreign bodies have been found which had been lodged for years in the substance of the heart, and others who bore the plainest marks of old scars. Nor are similar cases by any means so uncommon as is sometimes supposed in the human subject. Fischer has recorded 452 cases in which wound of the heart or pericardium was diagnosed, and out of these 72 recovered, and the diagnosis was in 36 cases verified to the satisfaction of the surgeon by post-mortem examination.

In a case, the preparation of which is in the Museum of St. George's Hospital, the symptoms were at the time ill-marked, though the heart was perforated, the bayonet having passed through the wall of the left ventricle, and opened its cavity. The patient was a young man, a Volunteer, who accidentally fell on his bayonet. He withdrew the weapon, ran a short distance, and then fainted. When seen at the Nottingham Hospital, an hour afterwards, he bore traces of great loss of blood internally, but this seemed chiefly in the left pleura, from which a pint and a half of blood was drawn off next day. On the day after the accident pericardial friction was detected. He lived four days.³

'The treatment,' says Mr. Poland, 'will be mainly directed to prevent

¹ On this subject consult Fischer, Ueber die Wunden des Herzens und des Herzbeutels, Langenbeck's 'Archiv,' 1868.

² Mr. Le Gros Clark describes and figures a most interesting case of bullet-wound of the heart, in which the man survived fourteen days, though there was a transverse laceration an inch in length in the right ventricle near its root, and the tricuspid valve was also lacerated (op. cit. p. 250).

³ 'Med. Times and Gaz.' 1863, vol. ii. p. 487. St. George's Hospital Museum, ser. vi. No. 224.

and arrest internal hæmorrhage, by absolute repose, local and general employment of cold, and early venæsection to relieve the heart'; and he also recommends the internal use of belladonna and digitalis.

Paracentesis of the pericardium has been contemplated in wounds of the heart in order to disembarass the heart of the effused blood, but has never been performed for that cause. It has, however, been occasionally resorted to when effusion into the pericardium, the result of disease, could be distinguished to such an extent as seemed likely to prove fatal. The operation is best performed in the fourth or fifth intercostal space, just to the left of the sternum, in exactly the same manner as paracentesis of the pleura,¹ or the parts may be dissected until the distended pericardium is exposed. In a case recently published,² the operation is thus described: 'A fold of skin having been raised over the fifth intercostal space, an incision a little more than an inch long was made parallel to the ribs, in the centre of the space, commencing about two-fifths of an inch to the left of the sternum. The layers of muscle were then carefully divided, and an elastic dilatation was felt, which resisted a little under pressure, while the impulse of the apex of the heart could be indistinctly perceived. A puncture having been made in this, the point of a small trocar was introduced, and about 10 ozs. of fluid were removed, with immediate relief.'

Paracenteresis pericardii.

Two cases are now on record in which a purulent collection diagnosed as having been contained in the pericardial sac has been evacuated by a free incision, washed out, and drained with complete recovery. My colleague, Mr. Rouse, has also recently operated on a case of this nature. After having twice aspirated the pericardium in the fourth intercostal space of the *right* side, and the pus having again accumulated, he made a free incision in the same situation, and having evacuated the pus and washed out the cavity, introduced a drainage-tube. The boy made an excellent recovery; the tube was finally withdrawn in about six weeks, and the wound speedily closed. A paper by Dr. S. West, recently read before the Royal Med. and Chir. Soc.,³ records one of these cases, and gives the statistics of the operation of paracentesis pericardii up to the date of publication.

Evacuation of pus in the pericardium by incision.

Many great vessels may be wounded in the cavity of the chest, but the only cases which need engage our attention, since they are the only ones susceptible of definite diagnosis and treatment, are the wounds of the internal mammary and of the intercostal arteries, and these are very rare, at any rate as substantive injuries. It is possible that an intercostal artery may be occasionally injured in fracture of the ribs, but I am not aware that this has been proved by dissection. The internal mammary artery may be wounded in any of the first three spaces by a stab-wound on either side of the sternum without any division of the costal cartilages. Below the fourth costal cartilage it is said that it can only be divided by section of the cartilage, and in more than half the cases that have been noted the costal cartilage has also been cut.⁴ An artery laid open through a wound of so dense a structure

Wounds of the internal mammary and intercostal vessels.

¹ On paracentesis of the pericardium see Allbutt, in 'Lancet,' June 12, 1869.

² 'Lond. Med. Record,' May 5, 1875, p. 275.

³ 'Med.-Chir. Trans.' vol. lxvi. p. 235. An interesting case is also reported by Dr. Mac Donald of Nova Scotia. 'Brit. Med. Journ.' Oct. 27, 1883.

⁴ See Tourdes, 'Annales d'Hygiène Publique,' vol. xlii. p. 165, where summary notes are given of eleven cases: in five of which, however, the diagnosis was not verified by post-mortem examination. This author insists strongly on the necessity of ligature of

as the costal cartilage can hardly be brought into view. When the artery is wounded in any of the upper three intercostal spaces it may, according to M. Tourdes, be tied by direct incision.

The intercostal artery may be wounded in paracentesis or in a punctured wound or gunshot injury, and it may be perfectly impossible to secure it in consequence of its remote position as well as the retraction of its divided ends.

It is not easy in either case to distinguish the source of the bleeding, though there would be less doubt in the case of the internal mammary artery than in that of the intercostal. The symptoms of bleeding from the latter differ but little from those of hæmorrhage from a wound of a vessel in the lung, for in accidental injuries at least (as distinguished from surgical operations) the lung is in all probability wounded. The main diagnostic sign is the effect of pressure with the finger introduced into the wound, which may be enlarged for the purpose. It has also been proposed to introduce a strip of card or a thin spatula into the wound, and judge of the source of the hæmorrhage by seeing on which side of the card the blood runs down. If the card is introduced into the pleura beneath the intercostal artery, it is clear that if that artery be the source of the bleeding the blood will run along the outside of the card, and if the bleeding be from the lung, along its inside.

The treatment of wounds of either of these vessels has generally been unsatisfactory. There are, indeed, some cases in which the surgeon can tie the wounded artery, but they are exceptional. In other cases it may be possible to keep up pressure by the fingers of a relay of skilled assistants long enough to avert death by hæmorrhage: or possibly the plan of uncipression recommended by Signor Vanzetti might find its use here (see page 109); or the following plan may be adopted. A fold of antiseptic gauze is to be laid over the wound and its centre pressed into the pleural cavity with the point of the finger inserted between the ribs, leaving the margins outside. The bag thus formed is to be stuffed with antiseptic wool and tightly tied around its neck. By slightly withdrawing the bag, and fixing it, firm compression of the wounded artery against the rib is made and the hæmorrhage may in this way be arrested. Many good surgeons, however (as Larrey,¹ in the case of the internal mammary, and Assalini in that of an intercostal artery), think that the patient has on the whole a better chance of recovery if the wound is simply closed, and coagulation is trusted in to repress the hæmorrhage, paracentesis being performed if the blood accumulates in the pleura² to such an extent as to threaten life.

Rupture
of viscera
without
wound or
fracture.

The heart is sometimes ruptured even in cases where there is no direct injury to the chest. Thus, in the case of a mason's boy who fell from the roof of St. George's Hospital and was killed on the spot, among other fatal lesions the septum ventriculorum of the heart was found ruptured without

this vessel when wounded, but I am not aware that the operation has ever really been practised.

¹ Larrey speaks thus: 'It is much better to leave hæmorrhage from the intercostal or internal mammary artery to nature. The wound being closed, the blood accumulates in the thorax, and the lung, no longer compressed by the air, dilates again and fills up the cavity.'—*Clin. Chir.* vol. ii. p. 181.

² In wounds of the internal mammary, low down, even the pericardium may be opened and may be filled with blood.

any other injury of the chest. But such lesions hardly come within the range of practical surgery.

In severe contusions of the chest (and usually from the passage of a carriage-wheel over it) the lung is sometimes lacerated without the chest-walls sustaining any visible injury. Doubtless at the time of the accident the glottis is spasmodically closed, and then the lung is torn between the force impressed on it through the chest-walls and the resistance of the air confined in the bronchi. The injury is only likely to take place in young persons, and frequently occurs at the root of the lung. When the large vessels in this situation are torn, speedy death is the result. When the pleura is also ruptured the diagnosis is more easy. The symptoms in that case will be hydro-pneumo-thorax (dulness at the lower part of the chest, sonorous resonance at the upper, and metallic tinkling, possibly with splashing on succussion), and at the same time dyspnœa, hæmoptysis, and sometimes subcutaneous emphysema, without any fracture of the ribs. When the pulmonary pleura has not been ruptured,' says Nélaton,¹ the signs observed are those of a cavity. Then the ear, applied to the chest, will perceive a gurgling, and will hear vocal resonance, and lastly, in some cases, metallic tinkling. To which I will add, after the same author (see p. 214, footnote), that there is sometimes emphysema at the root of the neck. All these symptoms were strikingly illustrated in a case, reported in the Clinical Society's Transactions,² which was further remarkable as presenting the puzzling complication of entire absence of breathing in the injured lung. The treatment is directed to avoid and combat the resulting inflammation, as in any other severe injury of the chest, and there can be no doubt that some cases end in recovery.³

The present seems the best place to introduce a description of the operation of paracentesis thoracis, or thoracentesis.

Paracenta-
tesis tho-
racis.

Tapping the chest is a very simple operation, and is required in cases of hydrothorax, empyema, and hæmothorax. It is, however, in cases of hydrothorax that it is principally resorted to, and as the object in these cases is to avoid the entrance of air in place of the fluid removed, some form of exhausting syringe is generally used. At present Dieulafoy's aspirator is commonly employed, and certainly answers its purpose admirably (fig. 69). The point of selection is a spot in the fifth intercostal space in the mid-axillary line, and the puncture is to be made near the upper border of the lower rib, since the main intercostal vessels run near the lower border of the upper rib. The best plan, I think (unless the parietes of the chest are unusually thin), is to make a lancet-puncture on the lower rib, put a finger-nail into the puncture, and enter the trocar along the finger-nail. The instrument, the walls of the chest, and the operator's hands must have been previously thoroughly disinfected with a solution of carbolic acid or other antiseptic. After the fluid has been withdrawn the small wound is covered with cotton-wool and collodion. If the lungs are bound down by adhesions, and attempts to exhaust the fluid are made with considerable force, the atmospheric pressure, acting through the air-passages on the tissue of the lungs, is no longer balanced by the pressure of the parietes, and the tissue of the lungs is forcibly thrust towards the chest-wall by the air inside them, to their great detriment. This may cause tearing of the lungs and hæmor-

¹ 'Path. Chir.' vol. iii. p. 494.

² 'Clin. Soc. Trans.' vol. xix. p. 244.

³ The chief authority on this subject is M. Gosselin's elaborate article in the first volume of the 'Mém. de la Soc. de Chir. de Paris.'

rhage into the pleural cavity. If therefore a patient complains of pain after a certain amount of fluid has been withdrawn, the operation should be at once desisted from, but may be repeated in a day or two. If the fluid is purulent, some further operative interference will probably be necessary. It is right, first of all, to try the effect of emptying the pleural sac of pus by means of the aspirator, if the pus has only been there a short time, and in a certain percentage of cases a cure may be effected. In the majority of cases, however, the pus will reaccumulate rapidly, and then it is necessary to drain the cavity at once. The longer this operation is delayed, the more firmly will the lung become bound down by adhesions and the less probability will there be of its expanding. As regards the best position for the opening, considerable difference of opinion exists, but it would seem, on the whole, that the point recommended for tapping the chest, viz. the fifth space in the mid-axillary line, is the best. Some surgeons select a spot lower down and farther back, in the seventh, eighth, or ninth space in the post-axillary line, or just below the inferior angle of the scapula, on the ground that this

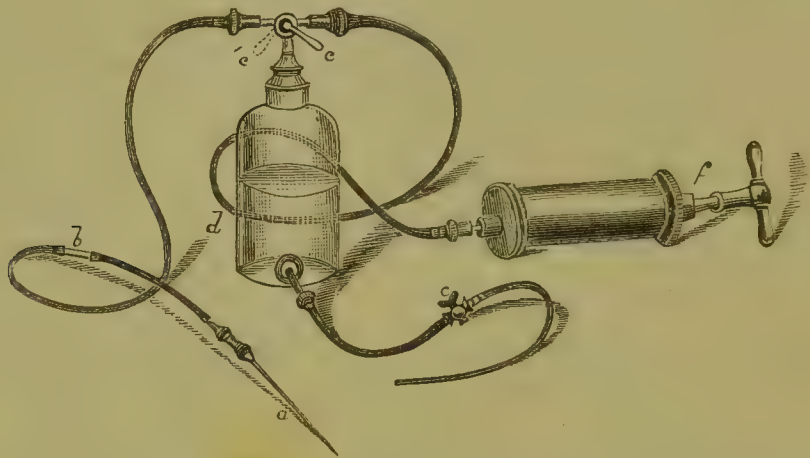


FIG. 69. The aspirator. *a*. The perforated needle or sharp-pointed cannula, which is introduced into the collection of fluid. It communicates with the bottle, *d*, by means of an indiarubber tube, which is interrupted at *b* by a portion of glass tubing, so that the nature of the fluid evacuated can be judged of at once, and the cannula either plunged deeper or withdrawn. When the handle, *c*, is in the position shown in the figure the communication between the cannula and the bottle is closed. The bottle is then exhausted of air by means of the pump, *f*. When *c* is moved to *c'*, the cannula tube is opened. *e* is the waste-tube of the bottle, and is closed by a button at *e*. In using the aspirator the vacuum is formed, and the handle, *c*, is kept in the position shown till the cannula has been introduced into the fluid; then the handle is turned to *c'*, and the fluid fills the bottle. If there is still more fluid, the handle is turned back to *c*, the waste pipe opened, and the fluid emptied out of the bottle, which is then again exhausted, and the handle turned back to *c'*. This is one of the simplest of the many forms of the aspirator.

is the most dependent part. This, of course, must vary with the position of the patient, and when lying on the affected side the mid-axillary will be the most dependent part. Moreover, in this situation the ribs are less thickly covered with muscles, and are wider apart, so as to admit of the introduction of a larger drainage-tube, and as the lung expands this is the last part of the chest-wall with which it comes in contact, so that there is no chance of any fluid being left behind if the opening is made in this situation. Marshall has recommended a point outside and below the line of junction of the fifth rib with its cartilage, on account of the thinness of the coverings of the chest in this situation, and because he believes that this is where an empyema naturally tends to point; but experience has not proved that any advantages are gained by selecting this spot.

The operation should be performed with strict antiseptic precautions, including the use of the spray. This, I believe, in these cases, to be a matter of considerable importance, for as soon as the opening has been made in the

chest, air is sucked in at each inspiration and becomes freely mixed with the fluid in the chest, and thus may give rise to putrefaction if the air has not been rendered aseptic by the spray. An objection to its use has been urged in that it chills the patient's body and is likely to produce cold ; but if the chest is covered with a macintosh sheet, with a small opening in it, corresponding to the site of the operation, similar to that in use in cases of abdominal section, this danger is entirely obviated. An incision is to be made, an inch and a half in length, along the upper border of the sixth rib, and the dissection carried down to the pleura. Before this is opened, all bleeding should be stopped. The pleura is then to be incised for the whole length of the wound and the pus allowed to escape. The finger should now be introduced, and if this can be done easily nothing more is required except to introduce the drainage-tube and clean the wound. If, however, there is not room between the ribs for the introduction of the finger, it is better to excise a portion of a rib. The incision already made must be carried down to the periosteum covering the sixth rib, dividing it. With a raspatory the periosteum is now to be stripped off the bone, and an inch or so of the rib removed, with cutting bone-forceps. If the periosteum is carefully separated from the bone, the intercostal vessels will be carried with it and there will be no danger of their being wounded. Should, however, one of them be divided it can generally be secured by a ligature. The periosteum on the inner surface of the rib is then to be freely incised, so as to enlarge the opening into the chest and admit of the introduction of a full-sized drainage-tube. Different forms of drainage-tube are employed by different surgeons. The one I have always employed is an ordinary indiarubber tube, with a shield at the end, something like a tracheotomy tube ; but other surgeons prefer a silver tube, provided with rings at its outer end, by which it can be attached to the chest. It need only be sufficiently long to enter the cavity of the chest fully ; any further length of tube needlessly causes irritation. The wound is to be dressed with some antiseptic absorbent dressing, which will require frequent changing. Care must be taken not to remove the drainage-tube too soon. As long as a distinct cavity remains, the tube ought to be retained. When, on examination with a probe, no cavity can be found, and the discharge is reduced to a small amount of serous fluid, the tube may be first shortened and then finally withdrawn.

It will sometimes happen that the cavity will not close. The lung is covered over with a dense membrane consisting of thickened pleura and inflammatory exudation which prevents its expansion. The only plan is then to adopt some means which will permit the chest-wall to retract, in order that the cavity may be obliterated. It has been proposed, therefore, to excise a considerable portion of several ribs whereby this end may be attained, and the operation has frequently been performed.¹ As far as I can gather, however, the result has not been so satisfactory as would justify us in resorting, lightly at all events, to what cannot but be regarded as a very serious procedure.

¹ See a paper by Mr. Rickman T. Godlee ('Lancet,' Jan. 30, 1886), in which the author gives the notes of seven cases, in which he had removed portions of one or more ribs, but in only one had the opening completely closed at the time of publication of the paper.

CHAPTER XII.

INJURIES OF THE ABDOMEN.

Contu-
sions.

BLOWS on the abdomen are always to be regarded with some apprehension. They often produce a good deal of immediate shock, even when no permanent ill-effects follow. That a severe blow on the epigastrium may destroy life by mere shock, without any visible lesion, is an old doctrine which cannot be said to be exploded, although Mr. Pollock has shown that much of the evidence on which it rests is highly unsatisfactory.¹ If the fact is true its explanation is probably to be sought in some direct effect on the great sympathetic system around the semilunar ganglia, analogous to 'concussion' of the other great nervous centres. But the event is unquestionably a very rare one, and its treatment would resolve itself into that of collapse (see p. 113). The more formidable immediate dangers in contusions of the abdomen are rupture of one of the abdominal viscera, or laceration of the peritoneum, followed by acute peritonitis, or by chronic peritonitis, or suppuration in or beneath the abdominal walls.² Cases where there is no symptom of visceral lesion, but where the blow has been severe, and the pain is great or extravasation extensive, should be watched with much care. The bowels should be kept inactive for several days by doses of opium proportioned to the amount of pain, warm fomentations sprinkled with laudanum or turpentine should be applied over the belly, or leeches to the painful part; and all distension of the intestines should be sedulously avoided, the patient being kept on meagre diet given in very small quantity, at short intervals. If peritonitis comes on it must be treated according to the general symptoms and the patient's state of health. In all cases opium is to be given by the mouth, or morphia injected subcutaneously; in cases of sthenic inflammation I entertain no doubt of the good effects of mercury; and in such cases free bloodletting is very advantageous—twenty or thirty leeches to the abdomen, repeated if necessary—or even venæsection. In cases of low diffuse suppuration (whether internal or external to the peritoneal cavity), with quick weak pulse, vomiting, tympanitis, and dry tongue, stimulants, even in large quantity, may be required. Suppuration near the seat of injury should be carefully watched for, and an early and free exit given to the matter. Lately, the familiarity which surgeons have obtained of other operations on the peritoneal cavity has encouraged them to treat acute peritonitis by direct incision and washing out the abdominal cavity copiously with antiseptic solutions. Instances of the success of this practice have been published by Mr. Treves and Mr. Howard Marsh.³ It is obvious, however, that very frequent failures must be anticipated, but I entertain no doubt that the treatment is very appropriate in traumatic cases.

¹ See 'Syst. of Surg.' 3rd ed. vol. i. p. 864. Mr. Le Gros Clark, whilst admitting the possibility of fatal shock without visible lesion, says that he has never met with such a case. (Op. cit. p. 267.) The present edition of Mr. Pollock's essay does, however, contain a case, which I think is conclusive as to the reality of the occurrence. (Op. cit. p. 867.)

² In some cases of severe contusion of the abdomen the muscles may be more or less lacerated. It is the rectus which is usually the seat of this injury.

³ 'Med.-Chir. Trans.' vol. lxxviii. p. 175.

Rupture
of the
stomach.

The stomach is very seldom ruptured without direct wound, and when this does take place the collapse is sudden and complete, and death occurs in a few hours. In a well-marked case published by the late Mr. Moore,¹ one of the main symptoms was the excruciating pain which was caused by the administration of small quantities of brandy. There will probably be urgent thirst, but there will be no vomiting, unless the rupture be very small or incomplete. No accurate diagnosis is possible, and therefore treatment can be of little avail. Mr. Pollock conjectures that in some cases of small laceration, occurring possibly between the attachments of the layers of omentum, the patient may temporarily recover, with a gastric fistula, and quotes a case which may be so interpreted.

The diaphragm may also be ruptured by a severe contusion. The only known consequence is a phrenic hernia. The subject is discussed in the chapter on *HERNIA*.

Rupture of
the bowel.

Rupture of some part of the intestine is a tolerably frequent and a very fatal injury. It occurs in any part of the bowel, 'from the commencement of the duodenum to the termination of the sigmoid flexure of the colon' (Pollock). The laceration varies in extent, being sometimes little more than a pin-hole, at others involving the whole or almost the whole circumference of the bowel.

The injury is caused by severe contusion, such as the kick of a horse or the passage of a wheel over the abdomen when the intestine is full; for there is no evidence, as far as I know, that the intestine can be ruptured when collapsed; and this is a very important distinction between rupture from contusion and perforation by direct wound. Many instances of sword and bullet wounds of the intestines have been recorded in which recovery has ensued, though the occurrence of fæcal fistula has proved the reality of the lesion of the bowel.² And such cases are easily intelligible if we suppose that the bowel was empty at the time of the wound, so that no fæcal fluid or gas escaped into the peritoneal cavity at the moment of the perforation. For the mucous membrane of the bowel protrudes at once through the lips of the wound in the muscular and serous coats, and, assisted by the contraction of the muscular fibres, so effectually closes the aperture that no extravasation takes place. By the time that the injured bowel becomes distended with fæces its wounded part has contracted adhesions to the neighbouring coils and to the parietes, so that the fæces find their way out of the external wound, not into the peritoneal cavity. This protrusion of the mucous coat occurs also in the case of internal rupture.³ But here, since the bowel is distended when ruptured, and since there is no exit for the contents except through the wound, there must occur instantaneously on the rupture a free escape of fæcal gas at any rate, and in all probability an effusion also of fæcal fluid into the peritoneal cavity, though the

¹ See 'Syst. of Surg.' vol. i. p. 876, 3rd ed.

² Amongst many other equally convincing cases I would refer the reader to one illustrated by a very striking photograph in the Circular No. 6 of the American Surgeon-General, Nov. 1, 1865, p. 26. In this case the ball had passed clean through the abdomen and emerged near the spine. There had been fæcal discharge from both wounds, and a mass of sphacelated omentum was discharged from one of them. Still the patient recovered, and was in perfect health at the date of the report.

³ See a case by Mr. Partridge, 'Path. Trans.' vol. xii. p. 109, where death occurred eight days after laceration of almost the whole circumference of the jejunum. The mucous membrane had so completely plugged the opening that there was no trace of extravasation of the contents of the bowel into the peritoneal cavity.

latter may sometimes be in such small amount as not to be discoverable after death. Thus the germs of fatal inflammation are in all probability implanted on the serous membrane; and there is not, as far as I can discover, any perfectly satisfactory proof that complete rupture through all the coats of the bowel without external wound has ever been followed by recovery. At the same time there have unquestionably been cases in which the symptoms have been held to justify the diagnosis of ruptured bowel which have ended in recovery; and the theoretical possibility of recovery, even in cases of complete rupture, has not been disproved; for we are not entitled to assert that the effusion of faecal gas must inevitably prove fatal; and there is again the remote possibility that although the bowel may be ruptured, yet the rupture may not implicate the peritoneum. Consequently the injury must be treated with a view to recovery.

Rupture of the intestine can generally be diagnosed, though sometimes not until too late for operative treatment to be of much avail. After a severe blow on the abdomen acute pain comes on shortly before the pain of the injury has subsided, often accompanied with much collapse (though not always so¹), with urgent vomiting, intense thirst, great tenderness of the abdomen, involuntary contraction of the abdominal muscles, usually rapid sinking, with coldness of the surface, lividity, and loss of pulse some time before death. As the case goes on, the vomit, which at first consists merely of food, becomes bilious, and then more and more resembles the contents of the small intestines; but I have never seen absolute faecal vomiting. Tympanitis usually succeeds, probably from paralysis of the bowel—the result of an impression on the sympathetic system of nerves. The collapse which depends on general shock may, as Mr. Le Gros Clark points out, be distinguished from that caused by hæmorrhage, since in the latter case ‘the patient usually refers his suffering to some isolated spot, where fulness or dulness on percussion, or both, may be detected.’

Treatment has hitherto been directed to prevent any re-opening of the laceration—i.e. to keep the lacerated bowel perfectly quiet until union has occurred; and this is the more important when we recollect that even if we believe all complete lacerations of the bowels to be fatal, yet we often see in cases of hernia the distended intestine partly lacerated on its external surface by injudicious violence, and that if the same thing took place in contusion it might produce symptoms very similar to those above described. Now, such an incomplete laceration would doubtless heal under favourable circumstances, if the part is kept at perfect repose, whilst distension and movement might easily render it complete, or set up fatal inflammation.

Absolute rest must be enforced—i.e. the patient must be not only confined to bed, but be prevented from making the slightest movement which can disturb the abdomen; opium must be administered in small doses often enough to relieve the pain, if possible, and to keep the bowels quite quiet, while any renewed distension of the intestine must be avoided by a rigid abstinence from food. For the first two days not a morsel of food nor a drop of fluid should be given, and then only just so much fluid nutriment must be given in very small quantities as will support life, and thirst must be alleviated by sucking small pieces of ice.

But there is no doubt that cases do arise in which abdominal section

¹ See, in ‘Syst. of Surg.’ 3rd ed. vol. i. p. 877, a striking instance of the complete absence of collapse an hour after the receipt of an injury in which the bowel was ruptured.

should be practised, the wound in the gut sutured, and the peritoneal cavity cleared of all clots and effused contents of the intestine. If there is reasonable ground for believing that the intestine has been completely ruptured, seeing that the injury is almost inevitably fatal, it is the duty of the surgeon to perform laparotomy, as giving the patient the only chance of recovery. And this should be done as early as possible after the receipt of the injury, otherwise a septic peritonitis will be set up which will materially diminish the prospects of a successful issue.

Rupture of the liver is a tolerably common injury, and one which is not necessarily fatal, though it usually is so.¹ Cases have occurred in which a rupture of the interior of the liver has been found, the peritoneal coat being untorn, and such injuries are evidently susceptible of repair, if they do not involve too large vessels. But it seems certain also that small lacerations of the surface of the liver may heal. I once saw a case² in which all the symptoms of laceration of the liver were certainly present. The man recovered, and, about a year afterwards, died from another cause. On dissection, traces of some injury were found on the surface of the liver, though it was impossible to say exactly what the extent of the lesion had been.³

Rupture of
the liver
or gall-
bladder.

Rupture of the liver is also sometimes produced by fragments of the ribs perforating the diaphragm. Such injuries are almost of necessity fatal. Uncomplicated rupture of the liver causes death primarily either by hæmorrhage or by extravasation of bile into the peritoneal cavity, and secondarily by peritonitis. When, therefore, the laceration extends into one of the large bile-ducts or the gall-bladder,⁴ the injury must prove fatal; and when the substance of the organ is so deeply broken up that several large vessels are laid open, the bleeding can hardly be expected to stop. It is only the more superficial injuries in which recovery can be anticipated. In cases which are not fatal from hæmorrhage, jaundice and clay-coloured motions may follow the injury.

The diagnosis of rupture of the liver must commonly be only conjectural, resting on the nature of the accident, the pain, and sometimes bruising, over the region of the liver (which is by no means always observed), the collapse, the symptoms of hæmorrhage, and occasionally the accumulation of fluid in the peritoneum.

The treatment must be, as in all other similar injuries, *absolute* rest, small and repeated doses of opium, the application of ice to the part, and possibly the administration of styptics.

If peritonitis comes on afterwards, the usual treatment must be adopted, though antiphlogistic measures must only be employed with the greatest caution.

The symptoms of rupture of the spleen are practically indistinguishable from those of rupture of the liver. The situation of the contusion, if known, will justify a conjecture that it is the spleen rather than the liver which is

Rupture of
the spleen.

¹ Mr. Le Gros Clark takes a still more favourable view of these injuries. He says: 'If the first effects of shock and hæmorrhage are survived, recovery from lesion of the liver or kidney is probably not infrequent.' (Op. cit. p. 292.)

² 'Path. Soc. Trans.' vol. xi. p. 140.

³ Mr. Pollock quotes from the records of St. George's Hospital a still more conclusive case. A man died from the effects of fracture of the spine three weeks after the accident. An extensive but not deep laceration of the liver was found, which had almost entirely healed. 'Syst. of Surg.' vol. i. p. 880, 3rd ed.

For a case of rupture of the gall-bladder see Fergus, 'Med.-Chir. Trans.' vol. xxxi.

ruptured, but no exact diagnosis can be made. The treatment, however, being identical, no importance attaches to the differential diagnosis. The spleen being a still more vascular organ than the liver, its laceration usually produces even more acute hæmorrhage.

Rupture of
the kidney
and ureter.

Rupture of the kidney is more common than that either of the liver or spleen, and it is a far less formidable injury, since it seldom involves the peritoneum. In fact, it seems probable that the real nature of the injury in many of the cases classified as 'ruptures' might be more correctly described as 'bruise,' there being probably no visible laceration. There is no doubt, however, that extensive lacerations may heal, and a preparation in the Museum of St. George's Hospital¹ shows a rupture which has divided the kidney into two parts and obliterated the ureter, but from which the patient entirely recovered, dying a year afterwards in consequence of granular degeneration of the other uninjured kidney.

The symptoms of uncomplicated rupture of the kidney are merely those of a bruise on the back, with pain in the lumbar region, collapse, the presence of fulness and dulness on the injured side, and hæmaturia occurring immediately on the injury. Hæmorrhage, however, is not always present, or may occur in very small quantities. In the case above referred to hæmaturia was very transient, lasting only a single day, for the ureter had evidently been obstructed by coagula, and thus all further hæmorrhage was suppressed. This, however, involved the entire loss of the kidney as a secreting organ. Generally the bleeding ceases gradually, and the viscus is probably not seriously altered in structure. In some cases, if the laceration has extended through the capsule, blood and urinous fluid get infiltrated around the kidney, and an abscess results, which usually presents in the loins, and to which an early opening should be given. Similar effects are attributed to laceration of the upper part of the ureter or of the pelvis of the kidney.² Many such cases have been brought to a favourable issue. When rupture of the kidney is complicated with laceration of the peritoneum in front of it, the blood and urinous fluid will pass into the peritoneal cavity, and the case will probably prove rapidly fatal. Such injuries are indistinguishable from laceration of the liver and spleen, with which they are frequently combined.

Death in uncomplicated rupture of the kidney is caused either primarily by hæmorrhage or peritonitis, or secondarily by cystitis, pyæmia, or abscess, and this abscess may either present behind in the loin, when speedy exit is to be given to the matter, or may make its way in front, and cause peritonitis even in cases where the peritoneum itself is quite uninjured.³ The treatment must therefore be directed at first to the suppression of hæmorrhage by complete rest, opium, leeches to the loins, and perhaps styptics (acetate of lead, gr. iij. every three hours, or gallic acid in 10-gr. doses every two hours), the bowels being kept freely open. If blood collects in the bladder the urine must be drawn off, and the clots washed away by a stream of water injected through a double-eyed catheter.

On the first indication of abscess an exploratory puncture must be made, and the abscess opened by the knife and freely drained.

¹ Ser. xi. No. 4. The case is reported in 'Path. Trans.' vol. xi. p. 140.

² See Stanley, 'Med.-Chir. Trans.' vol. xxvii., for two cases, one of which proved fatal. The pelvis of the kidney was found ruptured.

³ See Pollock, *op. cit.* p. 883. May not this be the explanation of a case reported by Mr. Le Gros Clark ('Lectures on the Principles of Surgical Diagnosis,' p. 333) in which rupture of the bladder was suspected?

Wounds.

Wounds of the abdomen are divided into (1) *superficial* wounds—those which implicate the parietes only; and (2) *penetrating*—those in which the peritoneal cavity is opened. Penetrating wounds may be (a) simple, i.e. there may be no indication of any injury to the viscera, or (b) the viscera may be wounded but not protruding, or (c) the viscera may protrude, but uninjured, or (d) the protruding viscera may also be wounded.

1. *Superficial* wounds are to be treated on the same principles as wounds in any part of the body, but with this caution: that as the subperitoneal space may very probably be laid open, in which hæmorrhage may go on to any extent, or in which suppuration may extend, producing irritation and inflammation on either, or both, sides of the peritoneum,¹ the surgeon should always be ready to enlarge the wound, with the view of securing any deep vessel which may be wounded, or of giving exit to inflammatory products.

In all cases of wound of the abdominal parietes the surgeon must also be most actively on the watch for the possibility of lodgment of foreign bodies. Many histories testify to the enormous size of foreign bodies which may be buried in the abdomen and may entirely escape observation for the time, though afterwards they must produce most serious mischief. It is quite true that exploration without urgent motive is a proof of very bad judgment, but when there is any reason to suspect the lodgment of a foreign body the wound should be very gently yet thoroughly explored, and the foreign substance at once removed.

Foreign
bodies
lodged in
wounds.

When any foreign body present has been removed and all bleeding vessels carefully secured, the wound is to be sewn up, and the patient kept in such a position as will keep the walls of the belly relaxed. Even if the wound is somewhat lacerated, it seems better to bring its edges into apposition. In cases of extreme laceration the surgeon must use his own judgment, inclining towards such an amount at any rate of apposition as will secure the patient against the protrusion of the intestines through the wound. Ventral hernia is a common consequence of abdominal wounds, which is spoken of in the chapter on HERNIA.

2. (a) Penetrating wounds, in which there is no indication of injury to the viscera, or in which the viscera, being exposed, are known to be uninjured, are to be treated in the manner so familiar to surgeons in operations for hernia and ovariectomy, i.e. they should be brought together by sutures through the whole thickness of the parietes, including the peritoneum, and the patient should be kept moderately under the influence of opium. The patient should be placed in such a position as will relax the abdominal walls, and kept absolutely at rest on a low diet of fluids.

Simple
penetrating
wounds.

(b) Wounds in which the viscera are wounded but do not protrude are amongst the most serious injuries met with in the abdomen, and, the smaller the wound is, the greater may be the danger. Gunshot wounds are spoken of in another chapter; the injuries commonly met with in civil practice are either stabs or incised wounds. In these the surgeon can often only suspect the visceral injury from the pain and collapse which are present, at other times the escape of the contents, urine, fæces, bile, or gas, through the wound affords a certain proof of the nature of the lesion. If there is undoubted evidence of a wound of one of the hollow viscera, i.e. stomach or intestine, I have no doubt that it is the duty of the surgeon to lay the peritoneal cavity

Wounds
of viscera
which do
not pro-
trude.

¹ I cannot say that I recognise the distinction which some authors endeavour to draw between diffuse peritonitis and diffuse subperitoneal inflammation. As far as I have seen they produce the same symptoms, and often coexist.

freely open, stitch up the wounded viscus, wash out the peritoneal cavity thoroughly, and afterwards unite the wound, treating the case with the strictest Listerian precautions.

Wounds
with pro-
trusion of
uninjured
viscera.

(c) When any of the abdominal viscera protrude uninjured through a wound, the first care of the surgeon should be to free their adhesive peritoneal surface from any small foreign bodies which may, and very often do, stick to them; then return them into the belly with as little violence as possible, and treat the case exactly as after strangulated hernia. The bowel or omentum protrudes much more often than any of the solid viscera or than the bladder. The intestine, if unwounded, should in all cases be returned, even though somewhat contused or abraded, and for that purpose, if the accumulation of air in the bowel, or the thickening of its coats from obstruction, has rendered it impossible to pass it back otherwise, the wound is to be gently enlarged by a very slight nick in one or two places, just as in hernia. A precaution is to be observed which is hardly required in hernia, viz. to be very careful not to push the bowel into an interstice between the muscles or into the subperitoneal tissue. The finger should be passed fairly through the wound, to make sure that the reduction has been complete. The omentum, though not absolutely wounded, is often so altered in texture from exposure or obstruction, or so beset with foreign bodies, that the surgeon may fairly prefer to remove it after passing a ligature through its base, of course making sure first that no bowel is implicated in its folds.

When any part of the solid viscera protrudes (which, however, rarely happens, except in shell or other gunshot wounds), the surgeon will be guided by the condition of the protruding part, and the ease of reduction, in his choice between returning it, encircling it with a ligature, or leaving it *in situ*; nor are such cases frequent enough (at least in civil practice) to enable me to lay down any definite rule, but in my own opinion the last course would usually be the best.

Splenec-
tomy.

The removal of the enlarged spleen, when the patient's life is threatened by the symptoms caused by it, has been undertaken many times, and occasionally with success. No precise directions are required for the operation, which is conducted somewhat after the manner of ovariectomy. The dangers, which are very great, depend chiefly on shock and on the possibility of rupture of the vessels in the pedicle before they have been properly secured, as well as on the tendency to secondary hæmorrhage, which is very great in cases of leucocythæmia. It seems that up to the year 1882 the spleen had been removed twenty-nine times—sixteen times for leucocythæmia, and thirteen times for various other morbid conditions. In none of the former sixteen did recovery ensue,¹ while eight out of the latter thirteen survived. No doubt in many of these thirteen cases the operation was superfluous. In none of them was the operation performed for injury or its results. In twenty-six cases the spleen (or perhaps in some only a portion of it) was removed on account of injury, and of these sixteen survived.

When any part of the bladder protrudes uninjured, a catheter must be

¹ Collier, 'Lancet,' Feb. 11, 1882. This author believes that the operation is unjustifiable in cases of leucocythæmia. On the other hand, one of the successful cases, which Dr. Collier classes as one of simple hypertrophy, is described by its author, Dr. Franzolini, as a case of leucocythæmia.—See 'Am. Journ. Med. Sci.' Oct. 1882, p. 483. Dr. Collier's opinion is further supported by Mr. Knowsley Thornton. See a paper ('Med.-Chir. Trans.' vol. lxi. p. 407) in which all the cases of this operation are tabulated to the year 1884. See also a letter from Dr. Collier, 'Lancet,' May 1, 1886.

passed, and after the bladder has been emptied reduction can hardly present any difficulty.

(d) If the omentum protrudes and is injured it should be removed. The solid viscera when protruding may be more or less lacerated, but the treatment of the case is not very much affected thereby. The best plan would be to put on a ligature or clamp tightly enough to restrain hæmorrhage, and leave things to themselves, treating the symptoms as they arise.

Wounds with protrusion of wounded viscera.

But the more common case is where the intestine protrudes and is opened. The prognosis depends mainly on whether any of the contents have escaped into the peritoneal cavity, whether the bowel is lacerated as well as incised, and whether it is or is not entirely divided. If the wound is a small punctured one, the mucous membrane becomes everted and blocks up the opening, and may prevent effusion. In a longitudinal wound there is less gaping than in a transverse one, and the case is more amenable to treatment. In some cases the gut may be completely divided, and perhaps even the mesentery wounded. Under all circumstances, whatever the size or position of the wound in the gut, it must be closed by a fine aseptic silk suture, introduced in such a way as to bring the two serous surfaces at the edge of the wound into contact, and without perforating the whole thickness of the wall of the intestine, as in the manner recommended by Lembert. When the whole circumference of the bowel has been divided, two courses are open to the surgeon: either he may join the two ends all round, with their peritoneal surfaces in contact, by Lembert's or Jobert's method, and then return the gut and sew up the external wound; or he may sew together the two portions of intestine in part of their circumference, and the rest he may attach to the edges of the wound in the parietes, thus forming an artificial anus. Probably this latter operation is to be preferred when the patient is much collapsed, as it is not so protracted a proceeding, or when the edges of the wound in the gut are lacerated and contused. In cases where the wounded gut is sutured and returned into the abdomen, the silk causes little irritation. It speedily becomes coated over by and buried in lymph, which shuts it off from the peritoneal cavity, and may remain encysted, or if it separates it does so into the cavity and is passed with the fæces.

The great point to be aimed at in suturing the bowel is to introduce the sutures in such a way that the two serous surfaces shall be brought into actual and accurate contact, and many plans have been devised for achieving this. The mode of application recommended by Lembert is the one most frequently adopted in the present day. This consists in introducing the needle through the serous coat about a quarter of an inch from the margin of the cut, and bringing it out again about the eighth of an inch from the margin on the same side. The needle is only made to penetrate the serous and muscular coats, and not allowed to transfix the whole thickness of the wall of the gut. It is then again introduced about the eighth of an inch from the margin of the opposite side of the wound, and brought out at a quarter of an inch from it (fig. 70). Great care must be taken not to penetrate deeper than the submucous tissue, and the sutures must be applied as closely as possible together, not more than the twelfth of an inch apart. All the sutures must be inserted before any of them are tightened. When this is done, the mucous membrane becomes inverted, and the two serous surfaces are brought into close contact (fig. 71). When the whole calibre of the gut has been divided, or when it has been so extensively torn and lacerated as, in the judgment of the surgeon, to require removal of the injured

Lembert's and Jobert's suture.

portion, the two resected ends may be joined by the suture recommended by Jobert. This plan of proceeding consists in turning downwards into the lumen of the tube the cut extremity of one end of the bowel for about one third of an inch. The other resected end is then invaginated on the top of this, and the two sewn together by sutures passed through three-

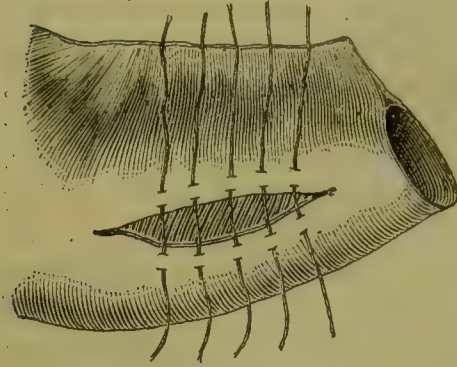


FIG. 70. Lembert's suture. From Sir William MacCormac's oration delivered before the Medical Society of London, 1887.

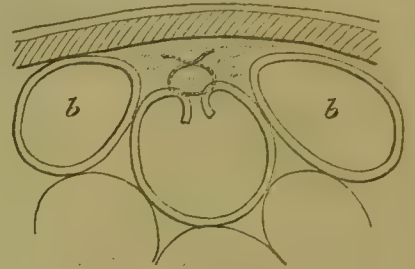


FIG. 71. Diagram of the repair of a wound in the bowel when united by suture. The suture is represented as being introduced in such a manner that it brings the peritoneal surfaces in contact without transfixing the whole thickness of the coat of the bowel. The shaded part represents the lymph which is effused around the wound, and which glues the wounded part of the bowel to the parietes of the abdomen or to neighbouring coils of intestine, *b, b*, or probably in most cases to both. When the suture separates it falls into the cavity of the bowel, while the effusion prevents the escape of the contents of the bowel into the peritoneal cavity.

layers of bowel. The mode of introducing the suture will be at once understood by reference to the accompanying diagram (fig. 72). A suture armed with a needle at each end is first passed through the upper end of the divided intestine about half an inch from its margin. The free edge of the lower portion of bowel is then inverted into the tube, and held there

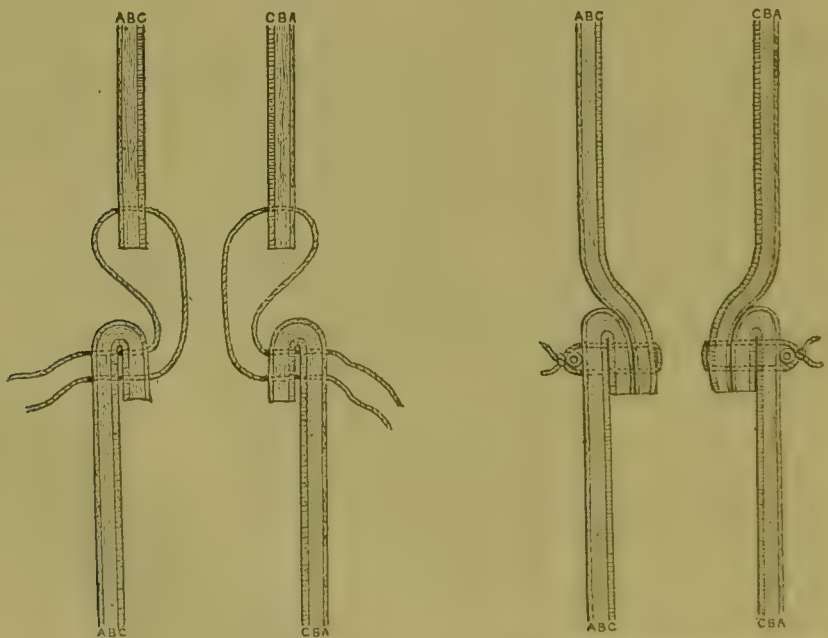


FIG. 72. Jobert's suture. A. Serous coat. B. Muscular coat. C. Mucous membrane.

with the finger and thumb, while the two needles are passed through the two layers of gut from within outwards; the one near the free margin, the other close to the folded border. A similar suture is then introduced on the opposite side of the bowel. By tightening the free ends of these two sutures, the upper end of the divided intestine is drawn downwards and becomes

invaginated into the lower, and may be fixed there by tying the two ends on either side together. For additional security it is well to introduce a series of superficial sutures through the serous coat, at the angle where the two portions of gut come together.

Foreign bodies which lodge within the stomach or intestines from having been swallowed are either ultimately voided per anum, or else they make their way by ulceration through the coats of the viscera,¹ and then usually cause death by effusion, or they may lodge in the tube and produce obstruction, or finally they may set up inflammation of the viscus and of the peritoneum without having caused perforation. Mr. Pollock divides these substances into: 1. Round and flat bodies, such as money, fruit-stones, bullets, pebbles, calculi. These are generally the least dangerous in their effects; 2. Materials which by accumulation form large masses, such as hair, string, the husk of the oat; such substances constitute the largest foreign masses met with in the food-tube; and 3. Sharp-pointed or cutting bodies, such as pins, fish or other bones, knives. These are generally attended by fatal consequences. The treatment in ordinary cases consists in avoiding purgatives, giving the patient opium, if necessary, to quiet the bowels and alleviate pain, and encouraging him to take a large quantity of bulky, constipating food, hard-boiled eggs, cheese, &c. This is well illustrated by Mr. Pollock from the plan pursued by coiners when detected in their attempts to pass false coin. They are usually able to swallow and get rid of even so large a piece as a half-crown, though the attempt is not without its dangers.²

Foreign
bodies in
the viscera.

Finally, in some few cases, the operation of cutting into the stomach and removing the foreign body may be justifiable, and ten cases at any rate are recorded in which that operation has been undertaken. When the body has passed through the stomach and is lodging in the intestine, its removal by operation is a matter of much more doubtful prudence, since even large substances will often ultimately come down to the anus. Yet in the case of a long pointed body, which can hardly be expected to get through the ileo-cæcal valve, the surgeon may feel justified in cutting down on it where it can be distinctly felt. The bowel must then be drawn to the surface of the wound, opened by as small an incision as possible, the body removed, the wound sewn up, the gut returned into the belly, and the case treated as a wound of the intestine.

There are other, very rare, cases in which a foreign body becomes lodged in the intestine, which has been passed up the rectum, and has from some unknown cause worked its way upwards. I once saw a boy who presented in

¹ In some cases foreign bodies, commonly pins or needles, are found under the integument which are said, to have been swallowed, and are believed to have travelled out of the stomach or intestine. In those cases where the part in which the substance presents is very far from the stomach, the probability of deception is very great, and it may be said generally that most of such cases are cases of imposition. But some are probably genuine. I once myself removed a crotchet-needle from the epigastrium with the hooked point lying directly under the skin, and from the circumstances of the case, as well as the position of the needle, believed that it had been swallowed. The reader who is curious on this subject will find an interesting paper on it by Mr. Doran in the 12th volume of the 'St. Bartholomew's Hospital Reports.'

² See 'Syst. of Surg.' 3rd ed. vol. i. p. 910, where a fatal case is reported in which a half-crown, lodged in the œsophagus, produced ulceration and fatal hæmorrhage from the aorta. Mr. Quain relates one in which a pin which had been swallowed passed through the vermiform appendix into the common iliac artery and caused death.—'Diseases of the Rectum,' p. 326.

the right iliac and lumbar regions of the abdomen a long, hard substance which seemed to be a foreign body, and seemed to be lodged in the cæcum and ascending colon. It occasioned little inconvenience. The boy could or would give no history throwing any light on the matter, and the diagnosis could be only conjectural. Ultimately a long piece of wood (I believe the greater part of a cedar pencil) passed from the bowel, which must have been pushed up the anus (though the boy would not admit the fact), since it neither could have been swallowed nor have passed through the abdominal wall. It is also possible that a foreign substance may have passed into the intestine in a gunshot or other wound which has not proved fatal, but such substances will only in the rarest instances lodge in the intestine.

The lodgment of foreign substances in the rectum, vagina, and bladder is common enough. The subject will be discussed in the next chapter.

Gastro-
tomy.

It remains to say a few words about the operation by which the stomach may be opened, and the indications for it. This operation is properly called *gastrotomy*; but unluckily, in consequence of the identity of the Greek term for the stomach and the abdomen, the same name is also sometimes applied to operations in which the abdomen is laid open, for the purpose either of relieving obstruction or of removing tumours.

Again, the operation of opening the stomach is performed on two different indications: (1) when a foreign body is to be removed, and when the surgeon hopes to restore the patient to complete health; and (2) when through injury to, disease of, or pressure on the œsophagus the patient cannot take food, and the intention of the surgeon is to rescue him from starvation and secure a permanent opening—a sort of preternatural mouth—in the walls of the stomach, through which food is to be introduced so long as the patient lives. The latter kind of operation is now often called *Gastrostomy*. Such operations are so rare that I must compress what I have to say about them into a very short space, referring my readers who wish to learn the details of the recorded cases to Mr. Durham's essay in the 'System of Surgery,' or to an interesting article on the subject by Dr. Pooley of New York, in the 'Richmond and Louisville Medical Journal' for April 1875. It is abundantly shown by these papers, which contain all the recorded cases of each kind, that *gastrotomy*, for removal of foreign bodies, is a very successful operation. Mr. Durham refers to ten cases in which foreign bodies were removed, and out of the whole ten only one died.¹ The analogy also of accidental wounds of the stomach in man, and of cases in which the operation has been performed experimentally on animals, shows that success may fairly be looked for, and would of itself amply justify the performance of the operation in cases where it is clear that the foreign body cannot pass the pylorus, or where its pointed shape or rough edges cause much danger from its sojourn in the stomach. Out of the ten cases the foreign substance was a knife in seven, and a fork in an eighth case.

Gastrostomy, i.e. the opening of the stomach in cases of obstruction of the œsophagus, can only be regarded as a palliative when the disease is malignant; but may afford the patient an indefinite prolongation of life when the obstruction proceeds from traumatic causes, and may, as it seems, even give time for the cure of the disease when, as sometimes happens, the œsophagus is obstructed from syphilitic stricture. Mr. Durham (op. cit. p. 800)

¹ 'Syst. of Surg.' 3rd ed. vol. i. p. 799.

says that he has obtained details of fifty cases of gastrostomy for cancerous disease, of which fifteen died within forty-eight hours, ten others within a week, fourteen others within a month, five others died in three months, and five survived over three months, one being still alive at the time of writing, more than six months after operation. This leaves one case unaccounted for. Out of eleven traumatic cases, death occurred in one on the fourth day from peritonitis, and in one on the twenty-eighth day from exhaustion. All the others seem to have done well, and in several cases the power of swallowing was regained to a greater or less extent. In one case under Mr. Davies-Colley's care, where the stricture was syphilitic, the patient entirely recovered, and the gastric fistula was closed nine months after operation.

The operation is generally performed by an oblique incision, about one finger's breadth below and parallel with the margin of the left costal cartilages, commencing an inch and a half from the median line and being about three inches in length. The skin, fascia, and muscles are to be severally divided, down to the peritoneum, and all bleeding arrested before this membrane is incised. Howse recommends, after dividing the superficial structures and exposing the sheath of the rectus muscle, that the edges of the wound should be stretched widely apart and the sheath incised longitudinally; the muscular fibres of the muscle are then to be separated (not cut) in the same direction, and the posterior layer of the sheath divided, and so the peritoneum is reached. By this means he thinks he secures a sphincter-like action of the fibres of the muscle around the tube after it has been inserted. After the peritoneum has been opened the stomach has to be found. It may present in the wound, and is recognised by its pink red colour and smooth surface. If the liver presents it must be pushed up; if the omentum, it must be pulled down. The next step is to suture the stomach to the opening. This is generally done by two rows of sutures. The stomach is drawn well over to one side, and a needle on a handle, armed with carbolised silk, is to be pushed through a fold of the serous and muscular coats of the stomach about an inch and a half from the point where it is proposed to open it. Care should be taken not to transfix the mucous membrane. The needle is then passed through the abdominal wall, from within outwards, about one inch from the margin of the wound. The silk is seized with a pair of forceps, and the needle withdrawn. It is now threaded on to the other end of the silk, and this is in like manner passed through the abdominal wall at a short distance from the other puncture. We have then the two free ends of the suture projecting from two wounds on the skin surface of the abdomen and the loop enclosing a bit of the serous and muscular coats of the stomach. Six or eight sutures are applied in this way in a circle round the wound and at about an inch from it. The free ends are to be tied over pieces of bougie, and in this manner the stomach is securely fixed to the abdominal wall, the two peritoneal surfaces being in contact. The inner circle of sutures are then to be introduced in order to fix the portion of stomach exposed to the lips of the wound. A small piece of the serous and muscular coat is to be seized with a pair of forceps or the fingers and transfixed with a curved needle, which is carried through the parietal peritoneum about half an inch from its cut margin and through the skin, without including the muscles (fig. 73). This is to be tied as an ordinary interrupted suture, and fresh ones inserted until the circle is completed. There are many other ways of fixing the stomach to the abdominal wall, but the one described above is that most commonly adopted; but it takes some time, a matter of moment

if the patient is in an exhausted condition. Some operators use merely two silk sutures, passed for a considerable distance under the outer coats of the stomach, but not into its cavity. Others after drawing a fold of the stomach out of the wound transfix it with a harelip pin or a thick silver wire supported by a harelip pin. And Mr. Howse has proposed to dispense with sutures altogether, and fix the stomach by means of forceps retained until it has adhered to the abdominal wall. Dittel has added the suggestion of stitching the parietal peritoneum to the external lip of the wound.¹ The operation should be conducted with strict Listerian precautions. If the symptoms admit of it, the parts are then to be left quiet for a few (say four or five) days. In more urgent circumstances it may be necessary to make the opening much earlier, or even immediately. An ordinary tenotome may be used for this purpose, and it ought to have been mentioned that at the first operation it is advisable to insert a ligature through the outer coats of the stomach, at the point where the opening is intended to be made eventually, as a guide, and also to support and act as a point of resistance by being held in the left hand of the operator while the knife is being plunged into the stomach. As

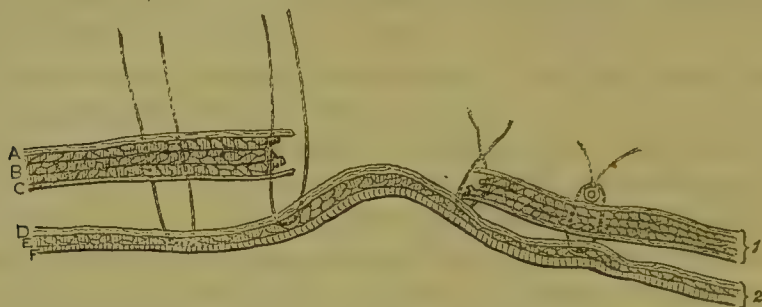


FIG. 73. Diagram illustrating the mode of introduction of the sutures in gastrotomy. 1. Abdominal wall. 2. Stomach. A. Skin. B. Planes of muscular fibres. C. Peritoneum. D. Peritoneum covering stomach. E. Muscular coat of stomach. F. Mucous membrane of stomach.

soon as the knife has reached the cavity of the stomach a No. 7 or 8 English gum elastic catheter may be passed along it and the knife withdrawn. Milk and brandy or beef-tea may now be injected, in small quantities at first, and in the course of a few days a soft red rubber tube may be substituted. Through this after a time finely minced meat can be introduced.

In the operation of gastrotomy for the removal of a foreign body the earlier steps of the operation are identical with the preceding. When the stomach is reached it is to be firmly held with catch forceps sufficiently far out of the wound to avoid all risk of escape of its contents into the abdominal cavity; a vertical incision is to be made, and the finger introduced to find the foreign body, which can then be extracted with polypus forceps or a blunt hook. Care should be taken not to make a larger opening in the stomach than is necessary. After the withdrawal of the substance the stomach wound should be closed by Lembert's suture, and the wound in the abdominal wall stitched up as after abdominal section. After the operation the patient should be supported by nutrient enemata, and no food given by the mouth for some few days.

¹ I would refer to the cases and observations of MacCormac, 'Brit.-Med. Journ.' Aug. 2, 1884; Macnamara and Fayan, *ibid.* Oct. 4, 1884; Chavasse, *ibid.* June 7, 1884; Barwell, Dent, and Morgan, 'Clin. Soc. Trans.' vol. xix.

CHAPTER XIII.

INJURIES OF THE PELVIS.

CONTUSIONS of the walls of the pelvis are very common from the passage of carriage-wheels over the body, from crushes of any kind, kicks, &c., and very large blood-tumours are often seen in the buttock under such circumstances. Many of the recorded cases of gluteal aneurism have been caused by rupture or contusion of the artery against the bone on which it lies. And even when the patient escapes without any serious ill-consequences at the time, yet disease of the bones may be subsequently developed—a malady which is only too frequently fatal. Such injuries should be looked upon with an amount of care proportioned to the violence inflicted; and remembering the frequency with which mistakes have been committed, in taking an old blood-tumour, or, still more unfortunately, a traumatic aneurism,¹ for an abscess, all possible care should be given to the physical examination of tumours in the buttock which follow after contusion. Auscultation and exploratory puncture should never be neglected in cases where any reasonable doubt can exist. It must be remembered that as these extravasations are below the gluteal fascia there is rarely any sign of bruise or injury in the skin.

Contusions
and wounds
of the but-
tock.

In wounds of the buttock the chief point is to determine the absence of foreign bodies. I have seen immense pieces of glass and other substances embedded in the buttock and quite overlooked. In deep wounds which penetrate to or near the great sacro-sciatic foramen and implicate the large vessels, the surgeon will require all his dexterity and anatomical knowledge in order to secure the gluteal, sciatic, or other wounded artery.² Yet, however difficult or severe the operation may be, it is urgently indicated, in order to save the patient from worse dangers. Possibly the application of Lister's tourniquet on the aorta may render the dissection easier and less dangerous, or the common iliac artery may be compressed by a piece of wood passed up the rectum, as practised by Mr. Davy in amputation at the hip.

Fracture of the pelvis is usually a very grave injury, less, perhaps, on account of the danger involved in the fracture itself—for the bones unite readily—than because of the great violence by which it is usually produced and the risk of injury to the pelvic viscera. There are partial fractures of the pelvis or fractures of the false pelvis which involve little or no danger. Such is the fracture of the anterior superior spine, or of the crest of the ilium, in its neighbourhood, which we meet with occasionally as the result of direct violence. There is pain in the part, and if only the spine is detached it is sometimes drawn down by the tensor vaginæ femoris or the sartorius, but more commonly there is no such displacement. Rest is all that is necessary, and

Fractured
pelvis

¹ See a paper on the 'Diagnosis of Aneurism,' in 'St. George's Hospital Reports,' vol. vii., and especially the case quoted on p. 181; also a case by Mr. Turner, 'Clin. Soc. Trans.' vol. xvii. p. 172.

² A very interesting case of wound of the sciatic artery, and of the subsequent ligation of that vessel, is recorded by Dr. Campbell of Montreal, 'Lancet,' 1862, vol. ii. p. 41.

the fracture will give rise to no serious inconvenience. Another fracture, the result of greater violence, such as the crushing of the body against a wall, is that which traverses the whole length of the false pelvis or ala of the ilium. This is a more dangerous injury than the former, on account of the possibility of lesion of the intestines which lie in the cavity. I remember well seeing a case in which, after an injury presumably of this kind (for its exact nature was not ascertained), the whole of the fæces were discharged through the outer side of the right buttock, evidently from a bruise or partial laceration of the cæcum, causing afterwards complete perforation of that intestine.¹ The patient ultimately recovered perfectly in all respects. As the viscera are far less closely connected with the false than with the true pelvis, such complications are less to be dreaded in fracture of the former. Fractures of the true pelvis are commonly double or multiple. Very often the two horizontal rami of the pubes give way, and the ascending rami of the ischium may be simultaneously fractured, so that the whole of the central part of the pelvis is loose, or the girdle is broken near the sacro-iliac joint on one side, and at the opposite end of the diagonal axis of the pelvis on the other.



FIG. 74. Fracture of the false pelvis irregularly united. The fragments are seen to be a good deal displaced, and at one part, *a*, is a perforation traversing the entire bone. The patient survived six weeks, and it is seen that the fracture is completely, though not firmly, consolidated. Besides this fracture of the false pelvis there was also fracture through the horizontal ramus of the pubes and ascending ramus of the ischium, separating from the rest of the bone the fragment which is absent in the drawing. These fractures were not united, and a small quantity of pus was found between the fragments. The patient, a girl of seventeen, had sustained other severe injuries, and died of pyæmic inflammation of the lungs.—St. George's Hospital Museum, Ser. i. No. 122.

But any kind of multiple fracture may take place, and on the other hand single fractures, as of one pubic ramus or of the ascending ramus of the ischium on one side, from limited violence, are not uncommon, and in these the entire pelvic girdle can hardly be said to be broken. The symptoms are usually unmistakable. In the complete fracture the patient cannot stand, and can hardly make any movement without extreme pain; displacement is easy to ascertain by examination from the rectum and vagina or from the outside, and crepitus can be elicited by grasping the two iliac spines and making attempts at rotation. It is well not to carry these passive movements too far, remembering the serious consequences which may ensue from the displacement of a pointed fragment. In the more limited fractures the symptoms

¹ Fig. 74 will illustrate the possibility of such lesion of the intestine, by the considerable displacement of the fragments of the ilium, and also the possibility of the discharge of fæces through the bone, by the large perforation in it marked *a*.

are of course less striking, but there is seldom any difficulty in making the diagnosis.

The prognosis will depend in a great measure on the presence or absence of visceral lesion. The rectum, bladder, urethra, small intestine, vagina, and perhaps even the uterus, may be wounded by a displaced fragment, or the bladder, if full, may be ruptured by the shock.¹ In the case of the urethra, which is most commonly wounded, there will be bleeding from the urethra, and if the bladder is injured the lesion will be testified by, sometimes, an entire inability to pass water, at others by the presence of blood in the water and the other symptoms of complete rupture. The small intestine is only implicated by very extensive injuries, which commonly prove rapidly fatal. If the rectum or vagina be injured the displaced fragment can be generally felt, and there will be bleeding from the part.

The treatment consists merely in complete rest. In the case of children or very restless adults the legs should be tied together, or the patient's move-

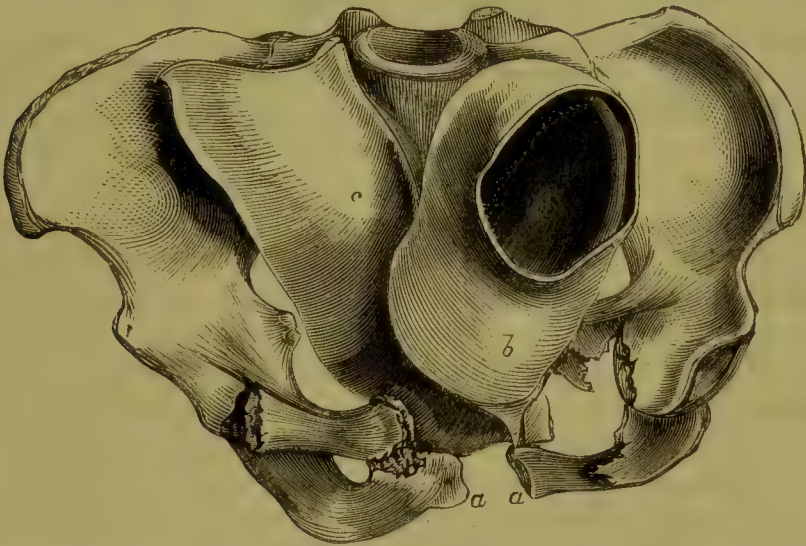


FIG. 75. Compound comminuted fracture of the pelvis. The patient, a boy at. 5, died next day, having received other severe injuries. *a, a* shows a separation of the symphysis pubis, which communicated with a deep wound passing down on the right side of the bladder, *b* (which was extensively separated from its connections on the right side, but was not lacerated), to the front of the rectum, *c*. The sphincter ani was partly torn on its anterior aspect, and there was bleeding from the anus; but the bowel was not further injured. The right pubic ramus is seen to be comminuted, separated from the ilium, and fractured at the crest of the pubes. There was also partial separation of one sacro-iliac synchondrosis.—St. George's Hospital Museum, Ser. i. No. 119b.

ments confined by a broad band pinned to the bed. The body should be so padded as to give the patient comfortable support in an easy position. If displaced fragments can be felt from the bowel or vagina they must be replaced if possible, for which purpose an anæsthetic is to be given. Nothing further is required beyond attention to the state of the bowels, catheterism if necessary, and a watchful vigilance as to the formation of matter, which should be at once evacuated. Probably in about six weeks² or two months, if all goes well, the patient will have recovered the power of standing, and when this is the case, but not before, he may be allowed to leave his bed. It is much better to keep him in bed longer than may be absolutely necessary, rather than to risk any relapse by too early disturbing the injured parts.

There are various other fractures which are more rarely met with, and to

¹ In rare cases some of the large nerves may be injured. The Museum of St. George's Hospital contains a specimen (Ser. i. No. 119) of fracture of the ramus of the pubes, in which the obturator nerve was injured. The patient died of tetanus.

² Fig. 74 shows how far repair may have advanced in six weeks, in early life.

Dislocation
of the
pelvis.

which our space will only permit a very short reference. Sometimes the line of fracture traverses the pubic symphysis (fig. 75), i.e. in strictness of speech, the two ossa pubis are dislocated from each other; and dislocation, more or less complete, of the sacro-iliac joint may also happen, though generally it is only a complication of more extensive injury.¹ As in the analogous case of the spine, the surgical considerations applicable to these dislocations differ in no respect from those of fracture in the immediate neighbourhood, with which, indeed, they are usually associated.

Fracture of
the acetabulum.

Again, fracture may originate in the acetabulum. It is not rare for an extensive fracture, starting from any part of the pelvis, to traverse the acetabulum, and such fractures, as in two beautiful specimens figured by Mr. Birkett,² may unite quite kindly, though probably not without shortening of the affected limb. But the injuries which are described as fractures of the acetabulum are twofold. One is a fracture of some part of the lip of the acetabulum, and this is believed to occur either with or without dislocation of the hip. I saw a case once of dorsal dislocation in which all the symptoms were strongly confirmatory of the diagnosis of fracture of the acetabulum. The dislocation was reduced without difficulty, and nothing peculiar was noticed, but on visiting the patient next day the surgeon was surprised to find that it had been reproduced. It was again reduced, but the reduction was found to be quite insecure, for it slipped out as easily as it was put in. And now it was thought that crepitus could be detected. The limb was put up as carefully as possible, but I believe that some deformity persisted. Fracture of the lip of the acetabulum without dislocation was believed by Mr. Benjamin Travers, jun.,³ to be the injury in some of those cases in which, without any proof of fracture of the neck of the femur, the upper end of the bone becomes afterwards changed in shape, so that shortening gradually comes on; but the truth of this opinion has not as yet been proved. One of Mr. Travers's cases was obviously an instance of chronic rheumatic arthritis complicated with a contusion. The acetabulum is sometimes driven in

Impaction
of the head
of the
femur in
the acetabulum.

by the forcible impaction of the head of the femur in falls on the trochanter, and this impaction in a celebrated case related by the late Mr. Moore ('Med. Chir. Trans.' vol. xxxiv.) had been so complete that the whole of the head of the femur had passed into the inside of the pelvis; yet the patient recovered. A few similar cases are recorded, though none, as far as I know, in which the impaction was so complete as this. The diagnosis from fracture of the neck of the femur is very difficult. The only case which I have myself seen was taken during life from an impacted fracture of the cervix femoris; but it is fair to add that the surgeon under whose care the patient was thought it better to abstain from any rigorous examination.⁴ If the head of the femur were completely wedged into the pelvis, as in Mr. Moore's case, I presume that, under chloroform, the complete immobility of the femur and the absence of any sign of dislocation would enable the surgeon to make at any rate a conjectural diagnosis; and if the impaction were incomplete possibly crepitus might be obtained, and might be felt also in other parts of

¹ In the 'Brit. Med. Journ.' for July 6, 1878, may be seen an interesting case, related by Mr. Thoresby Jones of Chatham, of pure dislocation of the sacrum forwards, proving fatal by injury to the left external iliac vein.

² 'Syst. of Surg.' vol. i. pp. 916-17, 3rd ed.

³ 'Further Observations in Surgery,' 1860, p. 27.

⁴ The preparation is in the Museum of St. George's Hospital, Ser. i. No. 123. Mr. Holmes has since recorded a second case, which occurred in his own practice. 'Lancet,' vol. ii. 1887, p. 1269.

the pelvis, but I am not aware that any case of the kind has ever been minutely examined, nor is it, perhaps, justifiable to do so. Hence the diagnosis is as a rule only conjectural. As the treatment is exactly the same as for impacted fracture of the cervix femoris, this is a matter of no importance.

Lastly, the coccyx may be fractured or dislocated. This is commonly the result of direct violence, though it is said to have taken place also in parturition. The pain in the part, felt especially in sitting, and the result of exploration from the skin and from the bowel, will easily settle the diagnosis. Reduction can be accomplished by pressure and counter-pressure from the skin and rectum, and the patient must be kept at rest till movement is no longer painful.

Fracture
and dislo-
cation of
coccyx.

One of the most formidable consequences of contusion of the pelvis or lower part of the abdomen is rupture of the bladder. This occurs in both sexes, but is much more common in the male. The bladder may also be perforated by one of the fragments in fracture of the pelvis, or may be ruptured in fracture of the pelvis without any perforation. The rupture may be *intra-peritoneal*, that is to say a rupture which extends into and opens up the peritoneal cavity, and *extra-peritoneal*, a complete rupture of some part of the bladder which is uncovered by peritoneum, or an incomplete rupture, where the whole of the coats of the viscus are not implicated, *sub-peritoneal*, as it is sometimes called. The symptoms of intra-peritoneal rupture of the bladder are generally quite unmistakable. The patient loses at once all power of expelling urine, and when the catheter is passed, which is unattended with any difficulty, the bladder is found perfectly empty, or only a few drops of bloody fluid are drawn off. Frequently, on passing the catheter further, a large quantity of urinous fluid is drawn off from the cavity of the peritoneum.¹ There is frequently severe pain and collapse, but often also there is no collapse and but little pain.² Sooner or later, however, the usual symptoms of peritonitis will come on, and then the patient will probably sink. In the extra-peritoneal form, fracture of the pelvis is the usual cause of the lesion; the constitutional symptoms are less marked, the catheter does not leave the bladder, so that the urine is never drawn off, and symptoms of extravasation of urine in the hypogastric region soon appear.

Rupture
of the
bladder.

Two or three questions of interest present themselves in connexion with the subject of traumatic rupture of the bladder. First, as to the diagnosis. This, as I said above, is usually unmistakable. After a severe blow in the hypogastric region, with the history of a full bladder at the time of the accident, the patient immediately loses all power of passing water. It may be merely retention from shock, following on the contusion; and temporary retention from a blow on the abdomen is common, as it is also after surgical operations on the abdomen. But then the catheter will draw off a quantity

¹ Mr. Willett and Mr. C. Heath have remarked, as an aid to diagnosis, that when the catheter is introduced through the ruptured bladder into the peritoneal cavity, the flow of urinous fluid is more directly under the influence of the movements of respiration than it ever is when the bladder is not ruptured.

² I well remember the case of a man who applied at St. George's Hospital on a Monday morning, having received a rupture of the bladder on the previous Saturday evening from a blow or fall when fighting. He walked to the hospital and displayed no distress of any sort, except some pain in the part which had been struck, though on post-mortem examination the bladder was found extensively lacerated and communicating freely with the peritoneal cavity.

of urine proportioned to the period of retention ; and this urine will be free from blood, unless the kidney is bruised. Or it may be a case of laceration of the urethra, but then there will be considerable difficulty in introducing the catheter ; and if the catheter can be passed the bladder will be found full of healthy urine. There are, however, some cases in which the exact nature of the injury remains obscure. They are chiefly those in which the laceration affects the extra-peritoneal portion of the bladder, and where the urine, not finding so free an exit as it does when the rupture passes into the peritoneal cavity, the bladder preserves some power of retaining, if not of expelling, the urine. But there are other cases in which somewhat similar symptoms exist, though the laceration extends into the peritoneum.¹ In one such case I suspected that the laceration had at first been incomplete, and that the rent afterwards gave way ; but others are not susceptible of this explanation. The complete discussion of the subject would lead us too far in treating of what are, after all, very exceptional injuries. Another very interesting question is the possibility of recovery after traumatic rupture of the bladder ; and this is obviously connected with the situation of the rupture. If the rupture be entirely extra-peritoneal, there is no intelligible reason why recovery should not ensue ; and cases are recorded in which this injury terminated in recovery. But, as a general rule, in rupture from contusion, the bladder gives way at its upper part, and the rent extends freely into the peritoneal cavity. Is such an injury necessarily fatal if left entirely to itself ? As far as I know there is no case on record in which recovery has taken place after an undoubted rupture of the intra-peritoneal surface of the bladder, unless some means have been taken to get rid of the urine effused into the peritoneal cavity and prevent any further accumulation taking place. And until recently there has only been one case in which there is indubitable evidence of intra-peritoneal rupture having taken place and which has been followed by recovery. This is Dr. Walter's celebrated case.² Here the peritoneal cavity was laid open by an incision in the linea alba, and the urine and extravasated blood sponged out. A rent was *seen* in the fundus of the bladder two inches long. Mr. Rivington, in his excellent and exhaustive treatise on rupture of the urinary bladder,³ has collected several other cases of reputed intra-peritoneal rupture which have terminated in recovery. But he has also brought forward very cogent reasons for doubting whether these were cases of bona-fide intra-peritoneal rupture. Whether they were so or not, it is an undoubted fact that until recently intra-peritoneal rupture of the bladder was regarded as a most fatal injury, and one which, except perhaps in the few instances collected by Mr. Rivington, was always followed by death. Recently, however, a new plan of treatment has been adopted, which has been followed by such satisfactory results, that we can no longer regard rupture of the bladder as a necessarily fatal accident, even when the rupture involves the peritoneal cavity. This new plan of treatment consists in

¹ See a very characteristic case in Le Gros Clark, *op. cit.* p. 333, in which six or eight ounces of bloody urine were drawn off by the catheter, and the patient several times passed urine ; nevertheless there was a laceration of the bladder an inch in length communicating with the peritoneal cavity. See also a case under my own care mentioned by Mr. Rivington in his work 'On Rupture of the Urinary Bladder' (p. 140), in which the patient after the accident voided some bloody urine, and in whom two or three ounces were withdrawn upon passing a catheter. The rent was found at the post-mortem examination to be intra-peritoneal.

² Ranking's abstract, 1862, vol. ii.

³ Rivington, 'Rupture of the Urinary Bladder,' 1884.

direct incision into the peritoneal cavity, washing out the effused blood and urine, and sewing up the rent. Sir William MacCormac¹ has collected ten cases in which this operation has been performed, viz.: Abdominal section and suture of the bladder for an intra-peritoneal rent; but one of these cases ought to be excluded, as the bladder was only partially sutured, the upper part being left open and drained. To these cases must be added another by Mr. Holmes,² published since Sir Wm. MacCormac's paper. There are therefore ten cases in which this operation has been performed and in four of them with a successful result. Two cases by Sir William MacCormac,³ one case by Mr. Walsham,⁴ and Mr. Holmes's case. There can, I think, be little doubt that as surgeons become alive to the necessity of the operation and resort to it early, the percentage of successful cases will be materially increased. The other modes of treatment which have been adopted are to make a free incision in the perinæum, as in lithotomy, and drain the urine from the bladder as fast as it comes in, trusting to the powers of nature to absorb and get rid of the urine already effused into the peritoneum; or to wash out the peritoneal cavity, either by passing a catheter through the urethra, or through a wound in the perinæum, as often as the symptoms seem to call for it. A few cases have been recorded in which patients have recovered under this mode of treatment, but it is right to mention that these are amongst the cases in which Mr. Rivington doubts whether there was any intra-peritoneal rupture at all. Whether this is so or not, the greater amount of success which has attended the operation of laparotomy and suturing the bladder renders it imperative on the surgeon, in my opinion, to perform this operation in intra-peritoneal rents of the bladder. The order of procedure should be as follows. First, a perinæal cystotomy should be performed:⁵ this will enable the surgeon to make an exploration of the bladder and confirm his diagnosis; it will also serve as the most efficient means of draining the bladder after the operation. Then the peritoneal cavity is to be opened by an incision in the linea alba, and the slit in the bladder closed by fine sutures so inserted as to bring the peritoneal surfaces into contact without perforating the mucous surface. The serous cavity is now to be thoroughly cleansed by repeated washing, and the wound in the abdominal wall closed. The main success of the operation appears to depend upon its early performance, certainly if possible within twenty-four hours of the receipt of the injury.

Extra-peritoneal ruptures of the bladder are best treated by perinæal cystotomy, combined with free and early incisions into those parts in which the urine has been extravasated.

Another very formidable lesion in contusion of the pelvis is laceration of the male urethra, which, though seldom directly fatal, produces often the most formidable kind of stricture, and thus frequently proves fatal indirectly or condemns the patient to a life of misery. The injury occurs from a fall, blow, or kick on the perinæum, by which the urethra is caught between the contusing force and the pubic arch, and is lacerated just in front of the prostate gland. The laceration may be total—and probably it is so generally—but in some cases a portion of the tube remains entire, as I have known verified by dissection. There is bleeding from the urethra and often some bruising in the

¹ 'Brit. Med. Journ.' May 14, 1887, p. 1031.

² 'Lancet,' July 23, 1887.

³ 'Lancet,' 1886, ii. p. 1118.

⁴ 'Brit. Med. Journ.' 1888, vol. i. p. 191.

⁵ Mr. Holmes, in his case, was unable to reach the bladder after having sewn up the rent in the abdominal wall.

perinæum, though this is by no means necessarily the case. If the patient has been neglected the urine may be extravasated, and after a time the skin will slough—and I have known this sloughing assume considerable proportions; but usually either the patient passes no water for some time after the injury, or it produces no deleterious effect, for such inflammation and sloughing is not very common. The passage of a catheter reveals at once the nature of the injury. The point of the instrument passes into a cavity at the part mentioned (i.e. just below the pubes); and this cavity is often of large size, containing a good deal of bloody, urinous fluid. It is sometimes possible to pass the catheter into the posterior end of the urethra, and reach the bladder; and when this is done healthy urine is drawn off. The instrument may then be tied in, and the surgeon may wait for any subsequent inflammation or effusion, when free incisions are to be made. Usually, however, it is found impossible to reach the bladder thus. The patient must then be anæsthetised, put up in the lithotomy position, and an incision must be made through the whole raphé of the perinæum, extending freely into the above-mentioned cavity. Some surgeons recommend that the two torn ends of the urethra should be sutured together with a deep catgut suture. If this can be done, no doubt it is very desirable, but it seems to me that there would be considerable difficulty in accomplishing this object. As to passing a catheter into the bladder the views of surgeons differ. A free incision into the perinæum is doubtless all that is necessary for the moment. The urine will escape through the wound, and the patient—who is generally a lad or a healthy young man—will in all probability recover. As the parts consolidate it will become possible to pass the catheter, and for a time all will be well. On the other hand, the retention of a catheter in the bladder may occasion a good deal of irritation, and it may be necessary on that account afterwards to withdraw it. All this I admit; and on these grounds many of the best authorities dissuade any attempt to reach the bladder and leave a catheter in it. But it seems to me that if the catheter can be passed at first, and if the patient can bear it to be left in the bladder (which I know by experience that he very often can), the wound in the urethra unites much more kindly, and with far less tendency to that subsequent cicatricial contraction which is so painful a sequela of these contusions.¹ In any case the patient must be warned that it is only by the constant passage of the catheter after recovery, and that for an indefinite period, that he can hope to be free from the painful consequences of cicatricial stricture, which is the worst form of stricture, rapidly contracting till the passage is almost closed; peculiarly liable to be complicated with fistula in perinæo, and often so tight and irritable as to cause much difficulty and pain in passing the instrument. Further observations on the treatment of cicatricial stricture will be found in the section on STRICTURE.

Wounds
and other
injuries of
the peri-
næum and
male
organs.

Contusions and wounds of the scrotum are comparatively common. Extravasation produces a large ecchymosis, the colour of which is generally perfectly black. But it is rarely followed by consequences which can be regarded as at all serious, unless it is complicated by rupture of the urethra and extravasation of urine, when there may be extensive sloughing. Again, wounds of the scrotum are sometimes lacerated to a very great degree. The

¹ I once saw a man who had been under my care about four years previously, and who had been treated by introducing and tying in a large catheter from the first, i.e. from the original operation of dividing the perinæum. He had remained quite free from any trouble, and still passed No. 10 catheter at intervals with perfect ease.

whole scrotum may be torn off, and the exposed testicle or testicles may either be implicated in the injury or not. There are also wounds inflicted in attempts at self-mutilation in which the parts may be very freely removed. I was once called upon to treat a lunatic who had completely removed the whole of the generative organs—penis, scrotum, and both testicles¹—leaving only about a quarter of an inch of the penis. He recovered without any bad symptoms. Other injuries of the penis are rare, on account of its mobility and usually flaccid condition. All such wounds are to be treated on general principles. They are remarkably prone to rapid union and complete repair. It is singular to observe how completely the new tissue will cover the exposed testicles, and how well the cicatrix will replace the lacerated and removed scrotum. The testicle, though so exquisitely sensitive to contusion or pressure, is singularly indifferent to wounds, and has often been punctured by mistake in the operation for hydrocele, or incised in treating orchitis, with perfect impunity. In the instance above referred to nothing was necessary except to tie one of the spermatic arteries, the other having ceased to bleed, and the patient recovered rapidly under the use of simple water-dressing. But whenever the urethra is divided it is necessary either to keep a catheter in the bladder while it is healing, or to pass the instrument frequently; and if the penis is cut off the same precaution should be adopted as after amputation of the organ, viz. to keep the urethra permanently open by slitting it up and attaching the mucous membrane to the skin (see AMPUTATION OF THE PENIS). The most troublesome cases are those of wounds of the corpora cavernosa, which are apt to be followed by very distressing erections and by deformity of the organ. All wounds of the male organs of generation require very careful adaptation by means of sutures. And in wounds of the scrotum the extremely retractile nature of the dartos should be remembered. The testicles may be most freely exposed, and the surgeon be tempted to believe that the scrotum has been almost torn off, yet if the part be relaxed by the application of warmth and moisture for an hour or two, he may find that there is really little if any loss of tissue, and that the scrotum can be perfectly adjusted; and in such injuries if the spermatic cord is severed Mr. Birkett believes that its repair is not impossible, if the ends of the vas deferens are united by suture. At any rate the attempt seems worth making.

The painful consequences of contusion of the testicles are best combated by complete rest, supporting the testicles in some soft substance with warmth and moisture. If the patient suffers severely morphia should be injected subcutaneously.

Another injury which we meet with sometimes is that in which children in play, or sometimes in fright from having been beaten for wetting the bed, tie a string tight round the penis. The nature of the case is known at once by the swelling of the front part of the organ, and the deep groove seen behind the swollen part. Anæsthesia should be at once induced, and the string carefully divided on the dorsal aspect of the penis and removed. If this is not done I have seen the urethra, and in one case nearly the whole penis, cut through by the ligature, causing irreparable and most painful deformity.

Ligature
round the
penis.

Injuries of the labia and female perinæum from blows and kicks are common enough. The ecchymosis, as in the scrotum, is usually abundant

Injuries of
the exter-
nal female
organs.

¹ The parts are preserved in the Museum of St. George's Hospital, ser. xiii. No. 1.

and very dark-coloured. The skin may be more or less lacerated, and sometimes the perinæum may be slightly torn, but it is very rare for any serious laceration of the perinæum to be caused by a wound.¹ Nor are the consequences of contusion usually serious. If neglected, abscess may ensue, so that rest is to be enjoined, and the application of an icebag or evaporating lotion is generally advisable at first, in order to check the extravasation. Afterwards warm fomentation is more soothing and grateful.

Wounds of the vulva may involve the vagina to a greater or less degree, or may pass into the rectum or bladder, or the vagina may be torn in coitu;² but the vagina is more often wounded by the unskilful use of instruments in delivery, or by bungling attempts to procure abortion. The latter cases hardly fall within the surgeon's province. The main point to bear in mind in the treatment of wounds of the vagina is the probability of contraction from cicatrisation, and the great difficulty and pain which this will produce in sexual intercourse. So that all possible care should be used to maintain dilatation of the vagina during the union of the wound, and for some time afterwards.

The unimpregnated uterus is so small, so hard, so movable, and in so remote a situation that it can hardly be wounded except in complicated injuries in which this would be quite a subordinate feature. And the injuries of the pregnant uterus seem better left to works on obstetrics, since they could hardly be treated of adequately here. They are rarely the result of mere accident, but constantly occur in criminal attempts to produce abortion, and sometimes in unfortunate instrumental delivery, with or without want of skill. For a comprehensive account of the surgical aspects of these cases the reader is referred to the account by Mr. Birkett and Dr. Braxton Hicks in the 'System of Surgery,' 3rd edition, vol. i. p. 935 et sqq.

Either the rectum or the bladder may be penetrated by a wound. In the male sex the bladder can only be wounded through the abdominal wall or the rectum, but in the female it may be punctured through the vagina.³ In all such cases as those last mentioned the greatest care should be taken to sew up the wound at once, and keep a catheter in the bladder, when the wound will probably heal, if its edges are clean cut. In stabs of the bladder from the abdomen the risk of extravasation of urine is great, and they are very often fatal, and this danger is, of course, greatly increased when the peritoneal cavity is also implicated. I think it is usually desirable in wounds of the bladder to keep the viscus emptied by means of a catheter tied in, though on this subject the surgeon must use his own discretion, remembering the risk of lodging the point of the instrument in the wound. In other respects no treatment can be applied, except that which may be demanded by the symptoms.

Wounds in
the rectum.

Wounds of the rectum are produced usually by falling on a stake or railing. They are not generally fatal, and if not fatal they lead to no serious consequence. I am not aware that any case is recorded in which contraction of the bowel has been thus produced. But when the stake or other weapon has passed far in it may lacerate the peritoneal cavity, or the great

¹ I do not here speak of injuries to the external parts in criminal assaults, as this subject is best treated along with the questions of medical jurisprudence. The surgical injuries so inflicted are trivial.

² St. George's Hospital Museum, Ser. xiv. No. 108.

³ In the section on vesico-vaginal fistula will be found a reference to a singular case, in which that infirmity was caused by the passage of a pistol-bullet from the vulva through the vagina into the bladder.

vessels in the pelvis, or the bladder. The first-named injury may be regarded as inevitably fatal, and the second will probably be so. Of the third two cases are recorded,¹ one of which survived. No special treatment can be adopted in any of these forms of injury.

Foreign bodies may be introduced into the male or female urethra or bladder, into the vagina or rectum. They may also lodge in any of these situations in case of wounds, but this is most common in gunshot wounds; and as the surgical considerations are the same in all such cases the reader is referred on that head to the chapter on GUNSHOT WOUNDS.

Foreign bodies in the bladder and other pelvic cavities.

Foreign bodies lodged in the male urethra may commonly be extracted with the forceps, since they lie generally very far forward, and must be smooth and rounded, or they would not be introduced. But in some cases fragments of bougies or of other substances introduced may break off in the deeper parts of the urethra beyond reach of the forceps. The best plan then is to try and push the substance back into the bladder, and break it to pieces, or, if small, remove it entire with the lithotrite. If this is impossible, the foreign body must be cut down upon from the middle of the perinæum and extracted. Of the foreign substances which are lodged in the male bladder a fragment of an old worn-out bougie or gum-catheter is by far the most common, and these can usually be caught in a lithotrite, and if small extracted entire, while if of large size they can be cut to pieces and will pass of themselves. If the substance cannot be caught, or is too hard or too large to break, it must be extracted by lithotomy, and lithotomy in such cases is far more successful than in cases of stone, since the urinary organs are probably healthy. One of the most troublesome foreign bodies to deal with is a hairpin in the female bladder. It is not at all uncommon for the pin to be passed up the urethra, of course with its bend towards the bladder, and then to slip into the bladder and expand its points sticking into the mucous membrane, and awkward attempts at extraction will aggravate the mischief. The best treatment is to dilate the urethra sufficiently to introduce the finger, when the foreign substance may be dislodged, or be drawn down by a hook passed round its bent end, or its two points may be brought together and a tube or forceps applied round them.

Foreign bodies are sometimes passed into the vagina, and the patient is unable to extract them, and will not apply for relief till they have occasioned much mischief. I once saw a case in which the end of a phial was lodged in the vagina, and had made its way by ulceration into the bladder, causing a most formidable and perfectly incurable form of vesico-vaginal fistula. It is not uncommon for the string of a pessary to break, and the substance to be left in the vagina till it becomes very foul and offensive. All such foreign bodies should be removed at the earliest possible moment, under anæsthesia if necessary.

Foreign bodies in the rectum may be of very large size, but there is no difficulty whatever in extracting them under chloroform after dilatation of the anus; or if the surgeon judges it better they may be broken up, as is usually done with the hardened lumps of fæces which sometimes obstruct the lower part of the bowel. This can be effected with the handle of a spoon or with a lithotomy scoop. Harder substances may require a strong pair of forceps, or even cutting pliers. But in all cases the extraction of sharp-pointed fragments at once is imperative.

¹ By Sir Prescott Hewett, 'Path. Soc. Trans.' vol. i. p. 152; and by Mr. Buée of Slough, 'Syst. of Surg.' 3rd ed. vol. i. p. 924.

CHAPTER XIV.

INJURIES OF THE UPPER EXTREMITY.

ALL injuries of the shoulder, arm, forearm, or hand are less serious than the similar injuries of the hip, thigh, leg, or foot. The main reason of this is no doubt the freer supply of blood to the part; but even irrespective of this there is a specific difference in the effects of disease on the two limbs respectively. Thus gangrene of the arm is of far less consequence than of the leg, and a wound implicating the shoulder does not involve anything like the same danger to life as one of the hip.

Again, the fact that injuries of the upper extremity do not necessitate confinement to bed or to the house renders them in many respects less depressing than those of the lower.

From these and such-like considerations it results that the surgeon may venture on attempts to preserve the upper limb in traumatic injuries, or in lesions from disease, which in the lower limb would imperatively call for the removal of the diseased part; that when the diseased part must be removed he may venture on operations of excision or resection which would not be justifiable in the lower limb; and that even when he knows the parts to be damaged beyond the possibility of repair he may often think it the best course to wait for gangrene rather than remove any part which might ultimately recover itself.

And for the same reason minor injuries are susceptible of more active treatment in the upper extremity, because the surgeon is less apprehensive of the occurrence of suppuration from too early use of the part, or from friction or passive motion, and less apprehensive also of its results if it does occur.

Foreign
bodies.

Foreign bodies (thorns, needles, &c.) often lodge in the palm. They are frequently hard to detect, since a piece of indurated tissue may be mistaken for the end of the needle. Unless the patient is suffering much inconvenience, it is a good rule not to cut down on a supposed needle in the hand or foot without being able to feel both its ends. In some of these cases the point can be thrust through the skin without any incision.

Wounds of
the palmar
arch.

Wounds of either palmar arch are frequently troublesome in their treatment and dangerous in their results, in consequence of the very free anastomosis which takes place between the two arteries which form either arch. The superficial arch, it is true, is much less deeply situated, and, when wounded, it can be reached and secured, without wounding any other important structure, provided the patient be seen soon after the injury; but then, very frequently this is not the case: on the contrary, the parts have become so infiltrated with blood that it is impossible to find the bleeding orifice. And when the deep palmar arch is wounded its position beneath the great nerves and tendons renders it difficult to tie it without very serious injury to the structure and functions of the hand, even irrespective of any infiltration of blood.¹

¹ The deep arch may, however, be reached from the dorsum of the hand, by an incision running along the radial border of the first metacarpal bone, and dividing the origin

In these injuries the first object of the surgeon is to stop the bleeding long enough to allow the wound in the artery to close, and this can generally be done by careful pressure with pad and bandage,¹ assisted by the raised position of the hand, or by acute flexion of the elbow, whereby the brachial artery is compressed against the coronoid process, or by graduated pressure on the radial and ulnar arteries, or by a combination of the last with one of the two former methods. Such compresses, when once applied, should not be moved for several days, unless from absolute necessity.

Professor Vanzetti has lately suggested a method which he calls 'unci-pressure,' i.e. the pressure of a single or double hook on either lip of the wound, as described on p. 109, which seems especially suitable for these wounds of the palm, since it makes constant pressure on the bleeding orifice, without giving pain or producing either œdema or sloughing—symptoms which often necessitate the removal of the compresses applied to the wound.

If the bleeding cannot be thus suppressed by pressure in and above the wound, two courses are open—viz. either to tie both arteries of the forearm just above the wrist, or to tie the brachial artery at once. Like all operations in which an artery is tied higher up, in order to stop hæmorrhage from a wound below, both these methods of treatment are uncertain. The weight of authority seems, however, to be in favour of the ligature of the brachial at once, rather than that of the two arteries of the forearm. Ligature of one of the latter without the other appears nugatory. In some cases it has been deemed necessary to amputate the hand in order to save the patient from death by hæmorrhage; but I would repeat that careful plugging and pressure on the wound, immediately after the injury, will generally stop the hæmorrhage, and render all ligature of the arteries unnecessary.

In wounds of the hand and wrist it is very common for the large nerve-trunks and the tendons to be divided. The subject of nerve-suture will be referred to in the chapter on AFFECTIONS OF THE NERVES. Here it will be sufficient to say, that in all cases where the large nerves (e.g. the median or ulnar) are seen to be divided, their ends should be gently drawn together and united with one or two fine sutures. It seems also that the same treatment may be successfully applied to divided tendons. The retraction of the ends of the tendon renders it improbable that union will occur spontaneously, while, if they are drawn into place and united with carbolised catgut, they have been known to recover their functions.² The wound must be enlarged sufficiently to enable the operator to recognise the sheath of the tendon, which is then to be slightly incised, the ends of the divided tendon brought gently into apposition and secured with one or two sutures, and the limb put up in such a position as to relax the parts as much as possible. Every effort should be made to secure rapid union; pus, if it forms, should be at once evacuated, and passive motion commenced as soon as the wound has healed.

Suture of
divided
nerves and
tendons.

of the first dorsal interosseous muscle from that bone, the parts being rendered bloodless by Esmarch's bandage. Dr. Ogston of Aberdeen performed this operation in a most interesting and successful case, reported in the 'Brit. Med. Journ.' June 24, 1876. But this would only be practicable when the palmar arch is wounded close to its origin.

¹ A good way of securing these pads is to make pressure on them with a splint in front, which is connected with and supported by another splint behind the hand.

² See a paper by Dr. Chambers of Indiana in the 'Indiana Med. Journ.' Sept. 21, 1882.

Fractures
of the
clavicle.

The clavicle may be fractured in any part of its extent, but the middle of the bone is that in which fracture is by far the most common. The accident almost always takes place from indirect violence, i.e. from a fall on the hand or on the point of the shoulder. The common fracture of the clavicle is easily recognised in most cases by the characteristic displacement. The bone gives way at its most curved point. The outer fragment, to which the whole weight of the arm is now connected, falls downwards, and is possibly drawn down also by the muscles which pass from it to the arm. It is also almost always tucked inwards below the inner fragment by the action of the flaps of the axilla, or by the impulse of the fall, or by both. The inner fragment is believed by some surgeons to be raised by the sternomastoid muscle, but this seems unlikely, as the attachment of the rhomboid ligament is sufficient to prevent any such displacement.¹ No doubt, however, the displacement in this, as in all other fractures, depends a good deal on the direction of the line of fracture, and accordingly we see specimens in which the outer fragment lies on the same level, in front or behind the inner, and even above it.

This fracture is very rarely compound, and it is very rare for any serious complications to accompany it. But the nerves of the brachial plexus, or one of the large bloodvessels, may be injured. There is a specimen in the Museum in St. George's Hospital, showing the internal jugular vein punctured by a fragment of the clavicle, and Sir Robert Peel's death was produced by a somewhat similar injury. In some very rare cases of direct violence both clavicles are fractured simultaneously.

The fracture is susceptible of very complete repair, and in cases where there has been no displacement this will be unaccompanied by any deformity; usually, however, considerable displacement remains during life, though it entails no ill effects beyond the slight disfigurement. The periosteum appears to be often untorn, especially in early life, and possibly in some of these cases the fracture may have been incomplete, or of the 'green stick' variety, as shown in the figure on p. 121.

The method of union is often by an exuberant or provisional callus. The period of union is from three to four weeks, after which no apparatus is necessary, though it is prudent for the patient to carry his arm in a sling for a time. The number of different contrivances for the treatment of fractured clavicle

¹ See, however, a case related by Mr. Hulke, in which the sternal fragment was raised up at an angle of 45°. 'Syst. of Surg.' 3rd ed. vol. i. p. 948.

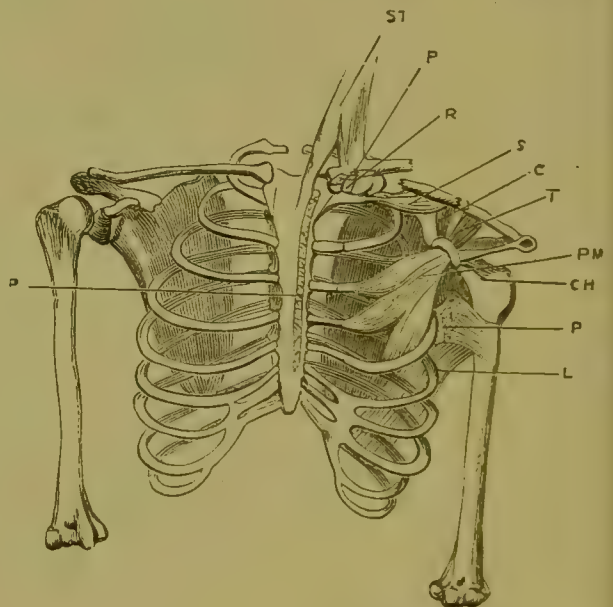


FIG. 76. Diagram of the common fractures of the clavicle (after Hind, modified). S T. Sternomastoid muscle. P P P. Pectoralis major muscle. P M. Pectoralis minor muscle. S. Subclavius muscle. L. Latissimus dorsi muscle. C. Conoid ligament. T. Trapezoid ligament. C H. Coracohumeral ligament. R. Rhomboid ligament. A fracture is shown in the usual position, and with the usual displacement—the outer fragment downwards and inwards—and the muscles are shown to which that displacement is generally attributed. Another fracture is shown between the conoid and trapezoid ligaments, and this fracture is shown as not being displaced, according to the general opinion.

testifies to the difficulty of keeping the bones in contact, and, in fact, it is always proper to prepare the patient's mind for the continuance of deformity. The old plan attempts to fulfil three indications: 1. Reduction is effected by drawing both shoulders backwards and raising the affected shoulder by the hand in the axilla, the surgeon standing behind the patient, and pressing his knee between the scapulæ. To remedy the displacement of the outer fragment inwards, the shoulders are then kept back by a figure-of-8 bandage encircling both axillæ and crossing behind. 2. Before applying the bandage a thick pad is placed in the axilla, in order to raise the shoulder and prevent the displacement of the outer fragment downwards. 3. Next, in order to obviate the tendency to loosening of these bandages, the arm and hand are encircled and bound to the chest by a broad bandage, which also fixes the scapulæ. All the turns of the bandage should be stitched together,

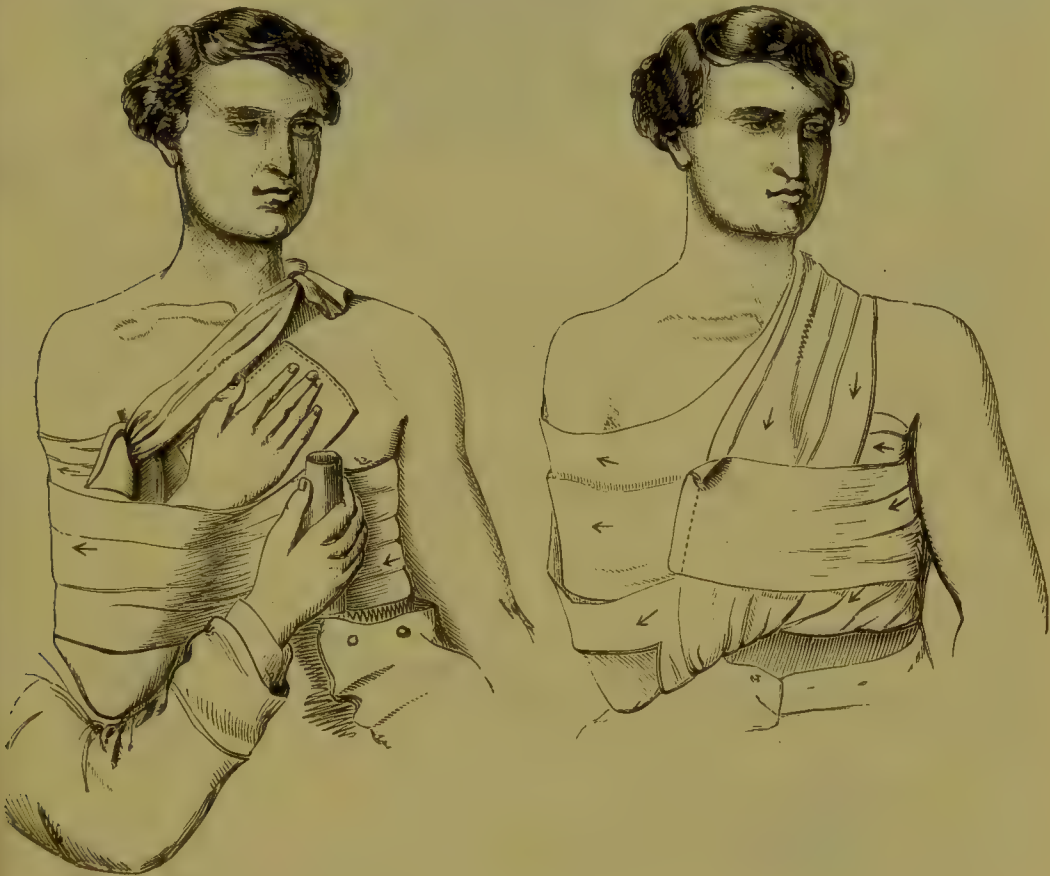


FIG. 77. Bandage for fractured clavicle commenced.

FIG. 78. Bandage for fractured clavicle complete.

or painted lightly with starch. This apparatus, however, can never be kept satisfactorily in position, and many surgeons object (and, I think, with reason) to the figure-of-8 bandage as liable to press on the outer fragment and displace it. A good and convenient plan is to put a short crutch into the axilla, which is fixed by a strap going across the opposite shoulder, and another round the body, and to carry the arm in a sling. Some surgeons recommend that the hand should be raised and bandaged on to the opposite shoulder.¹ A very good result may be obtained by perfectly reducing the fracture, and keeping the patient at perfect rest in the supine horizontal posture, any accidental fresh displacement being at once remedied. But very few persons, except young ladies careful of the future appearance of the neck, or persons laid up by other injuries, could be persuaded to submit to such an irksome

¹ Bryant, 'Practice of Surgery,' 2nd ed. vol. ii. p. 375.

treatment in order to avoid the very trifling deformity left by the fracture, since no real inconvenience results from it. Dr. Gordon combats the general views with regard to the cause of the displacement which is generally found in fracture of the clavicle. He regards elevation of the shoulder as worse than useless, and teaches that the essential indication of treatment is to carry the scapulæ outwards and backwards. This he does by applying a shield to the thorax and a metal collar to the arm, and connecting the two by a rod which can be lengthened or shortened by means of a screw.

Fracture
of sternal
end.

Fracture of the sternal end of the clavicle is not a common injury. It generally takes place about an inch from the end of the bone, and is accompanied by a well-marked displacement of the outer fragment downwards and forwards in front of the sternum, which has often been confounded with dislocation.¹ The treatment appears to be usually unsuccessful

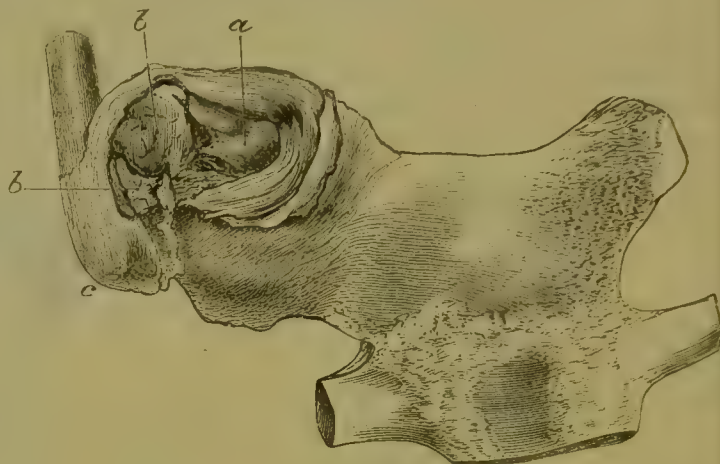


FIG. 79. Fracture of the sternal end of the clavicle, seven days before death. The situation of the joint is shown; the fracture is about an inch from the joint. *a* shows the proximal fragment. There is a large blood-clot (*b*) between the fragments. The outer fragment (*c*) is pointing directly forwards, i.e. its point pressed against the skin.—Museum of St. George's Hospital, Ser. i. No. 77.

in the same sense as in the common fracture; that is to say, that the displacement remains, but no serious loss of motion results. This fracture,



FIG. 80. A recent comminuted fracture of the left clavicle, from a case in which death was produced by other injuries in a few hours. *a*, superior, and *b*, inferior view. The external fragment has become placed below the inner one, and is at the same time directed forwards, so that the two fragments form nearly a right angle with each other. Two pieces of the inner fragment have been detached and are lying above it, as seen in *a*. Fig. *b* shows how the outer fragment has passed below the inner. The fracture is situated between the coraco-clavicular ligaments and the acromial joint.—From a case by Mr. Canton, in 'Path. Trans.' vol. xii. p. 161.

of course, lies external to the attachment of the rhomboid ligament. The occurrence of fracture internal to this ligament has not as yet been proved; its fibres would probably prevent any extensive displacement, though some movement of the inner fragment forwards would still, according to Professor Smith, be possible.

¹ On this head see a paper by Dr. R. W. Smith, 'Dublin Quarterly Journal,' Aug. 1870.

Fracture of the acromial end is a much more common injury, and is often accompanied by very great deformity, the effect of the mobility of the scapula, which, being now deprived of the natural support of the clavicle, carries the outer fragment inwards, so that it makes almost a right angle with the inner, and in some cases (as in that figured by Professor R. W. Smith, 'On Fractures and Dislocations,' p. 219) the sternal fragment is much elevated, while the shoulder is drawn inwards and forwards, thus adding greatly to the deformity.

Fracture of
acromial
end.

On the other hand, when the fracture happens to occur just in the interval between the conoid and trapezoid ligaments, there may be little or no displacement; at least, such is the common impression (as shown in fig. 76). Dr. Gordon thinks this impression incorrect, and believes that fracture between the conoid and trapezoid ligaments produces the same deformity as any other fracture of the outer end of the bone; in other words, he does not believe that these ligaments have any effect in resisting displacement, and I suspect that his opinion will be found correct.

All these fractures are to be treated on the same principle as the common fracture of the clavicle, i.e. to fix the shoulder in the position best adapted to prevent the displacement characteristic of each; but the difficulty of keeping the scapula fixed is a great obstacle to complete success. This may be combated by fixing a pad on the dorsum of the scapula below its spine and strapping it tightly to the chest; but when the tendency to displacement is considerable, the success of any plan will not be great while the patient is allowed to move about.

Fracture of the body of the scapula is usually the result of direct violence: the passage of a carriage over the body or a crush against some obstacle. It is usually easy of detection, for it generally passes through the spine of the bone, and in passing the finger along the spine the broken part can be reached at once, or the shoulder being grasped in one hand and the lower angle of the scapula in the other, the crepitus will be elicited. The fracture, if not complicated with other injuries—which, however, is very often the case—will not in all probability lead to any evil consequences. Should any displacement exist, the parts must be manipulated into position, but this is not generally necessary, since the broad muscles attached to the bone prevent any change in the relative position of the fragments. After reduction all that can be done is to apply a broad rib-roller, and even if the fracture consolidates irregularly no harm will result. In three or four weeks the patient may be allowed the free use of his arm.

Fracture of
the scapula.

Fracture of the neck of the scapula may, as it appears, involve either the anatomical or the surgical neck of the bone, the former being the constriction around the glenoid cavity external to the root of the coracoid process, the latter the part by which the glenoid fossa and coracoid process are connected to the body of the bone. Fracture, therefore, through the anatomical neck would separate only the glenoid process from the rest of the bone, while fracture through the surgical neck would separate the coracoid process also from the scapula and render it movable. The subject of fracture of the neck of the scapula is one on which much difference of opinion has prevailed, and which is still unsettled. Sir A. Cooper described it as an injury which often simulates dislocation of the humerus into the axilla,¹ and his description is expressly applied to fractures of the surgical neck of the bone, since he points

Fracture of
the neck of
the scapula.

¹ Cooper, 'On Dislocations and on Fractures,' 2nd. ed. 1823, p. 454.

out carefully 'that the coracoid process being attached to the glenoid cavity, and being broken off with it, the crepitus [of the fracture] is communicated through the medium of this process,' and the seat of the supposed fracture is marked in one of his figures. Other surgeons have explained differently the injury which Cooper classed as fracture of the neck of the scapula, some believing that the real lesion was a dislocation in which a portion of the glenoid process was fractured,¹ others that it was a fracture of the head of the humerus.'² But neither of these explanations seems to me at all consistent with Sir Astley's very clear description of the symptoms as observed by him; and although there is no dissection in existence from a case of this kind which can show on what precise injury the symptoms have depended, yet as there are certainly specimens in existence of fracture of the surgical neck of the scapula,³ and as it seems certain that such a fracture might produce the symptoms described by Sir A. Cooper, I see no reason for denying the accuracy of his diagnosis, though the fact that the injury can hardly prove fatal renders the anatomical proof of it hitherto deficient. The reader may consult a very interesting paper by Dr. Lotzbeck of Munich on this subject,⁴ in which the symptoms due to both of these varieties of fracture of the neck of the scapula are described, though only from the living subject, and the various opinions which have been expressed on the question are discussed. The symptoms in one of the cases there described 'much resembled dislocation; the arm was lengthened one inch, drawn away from the side, and the acromion prominent; but the injury was easily distinguished from dislocation by the fact that the coracoid process was also displaced, and moved with the arm in passive motion; that such movements were perfectly easy to produce, though very painful; the length of the arm was at once restored and crepitus obtained; and, finally, an irregular fragment of bone was felt in the axilla.' Dr. Lotzbeck also met with another case in which the symptoms were very similar, only that the coracoid process was not movable, and which he therefore believed to be a fracture through the anatomical neck of the bone. In both cases the displacement was reduced and good motion of the joint obtained. The diagnostic signs from dislocation are the ease with which the parts can be put into position, the production of crepitus, and, when this is done, the freedom of passive motion—though this causes much pain—and the sensation of a bony fragment in the axilla. It must nevertheless be admitted that the injury cannot be described with the same confidence as one whose nature has been conclusively proved by dissection.

Fracture of
coracoid
and acro-
mion pro-
cesses.

Fracture may also occur either of the coracoid or of the acromion processes alone. That of the coracoid is unquestionably rare as a separate injury, though as a complication of dislocation it is known to occur and is perhaps not extremely uncommon. The fragment is described as being drawn down by the biceps muscle,⁵ and it is said that ligamentous union is on that account

¹ Malgaigne, 'Traité des Fractures et des Luxations,' vol. ii. p. 551.

² Mr. South, 'Chelius' (vol. i. p. 549), says that this has been proved to be so; but if so Sir A. Cooper must have utterly misstated the symptoms of the case which he described.

³ One in Guy's Hospital Museum is figured in Mr. Bryant's work, vol. ii. p. 377; another is in the Museum of the Royal College of Surgeons.

⁴ 'Deutsche Klinik,' 1867, abstracted in the New Syd. Soc.'s 'Biennial Retrospect' for 1867-68, p. 240.

⁵ See a case described by Mr. South, 'Med.-Chir. Trans.' vol. xxii. p. 100. In this case the fragment was pulled down by the short head of the biceps muscle as far as the triangular ligament would allow—about half an inch below and to the outer side of the stump of the coracoid process.

common. I do not believe, however, that enough is known about the injury to enable us to judge whether this is generally true. The muscles attached to the coracoid process would only displace the fragment in the event of its being entirely torn away from the periosteum, and this I suppose to be rare. And doubtless the statement as to the frequency of ligamentous union in this fracture, as in that of the acromion, rests in a great measure on post-mortem examinations, in which additamentary bones around shoulders affected with chronic osteoarthritis have been mistaken for fragments of old non-united fractures. If fracture of the coracoid process is met with uncomplicated with other injury, and if the fragment is displaced (of which Mr. Bryant records an example under his own care), the arm should be bandaged with the elbow raised and the forearm flexed, so as to relax the biceps muscle, and the parts kept in that position for about a month.

Fracture of the acromion is easily diagnosed by tracing the spine of the scapula with the finger, an abrupt drop marking the seat of fracture. The mobility of the fragment and the dropping of the point of the shoulder will sufficiently prove the nature of the case, and the diagnosis will be confirmed by the crepitus. The surgeon will also notice how the deformity disappears on raising the elbow, and recurs as soon as the elbow is allowed to drop. 'In the treatment of this accident,' says Sir A. Cooper, 'the head of the os humeri is the splint which is employed to keep the acromion in its natural situation; and with this view the elbow is raised and the arm fixed.' He also points out the unadvisability of either putting a pad in the axilla or bandaging the elbow too closely to the side, since by both of these plans the head of the humerus is thrown outwards and the fragments separated. The surgeon should raise the elbow and fix it in that position, which places the bones in perfect contact, and endeavour to keep them thus for about three weeks; but it is somewhat difficult to keep the parts quiet, and to this Sir A. Cooper attributes the ligamentous union of fractured acromion, which he believes to be common, and in this belief he has been followed by most authors; but in this case also there is much reason to believe that specimens of old chronic rheumatic arthritis have been looked upon as examples of ununited fracture.¹ At the same time it is very desirable to realise the probability of non-union in this fracture, and to endeavour to guard against it.

Fractures of the humerus are divided into those of the upper end, of the shaft, and of the lower end. Those of the upper end of the humerus are: 1. Fracture of the anatomical neck (intracapsular); 2. Of the surgical neck (extracapsular); 3. Separation of the epiphysis; and, 4. Fracture of the great tuberosity.

Fractures
of the
humerus.

1. Pure uncomplicated fracture above the tuberosities—i.e. entirely within the capsule—is a rare injury, and its diagnosis is by no means easy. It is very generally accompanied with impaction, the shaft of the bone being sometimes driven into the upper fragment, whilst in other cases the head of the bone is more or less displaced and driven into the lower fragment (fig. 82). In a remarkable case recorded and figured by Prof. R. W. Smith the fractured head was entirely reversed, so that the cartilaginous surface had been driven into the shaft, while the fractured cancellous tissue was turned upwards towards the glenoid cavity.² The diagnosis is in many cases mainly negative.

Fracture of
anatomical
neck.

¹ Dr. R. Adams says that in chronic arthritis of the shoulder the acromion is often found to have undergone a solution of continuity from disease, and that this usually but not always occurs at the line of the epiphysis ('On Chronic Rheumatic Arthritis,' 2nd ed. p. 102).

² A similar specimen is figured by Hamilton. This author conjectures, with great

There are not the characteristic symptoms of any of the other fractures to be presently described, nor those of dislocation. If the fracture be firmly impacted no crepitus can be elicited, but some change of shape of the upper end of the bone may be made out, if not masked by the swelling. If, however, the fracture be not impacted, crepitus will be made out; and the surgeon being convinced that the scapula is not injured, and that the injury is seated above the surgical neck, and is not of the tuberosity only, must conclude that it is an intracapsular fracture. Much caution, however, is required not to confound the pseudo-crepitus of effusion into the sheaths of the tendons with the real crepitus of fracture. These fractures unite solidly by bone; in fact there is often a very exuberant production of stalactitic bone, especially when the head is impacted in the lower fragment, and the inflammation which produces this bony effusion must greatly limit the movements of the joint. The only treatment which can be adopted is to remedy any tendency to displacement of the lower fragment inwards which may be present, by means of a pad in the axilla, and to support the arm in a sling. In impacted

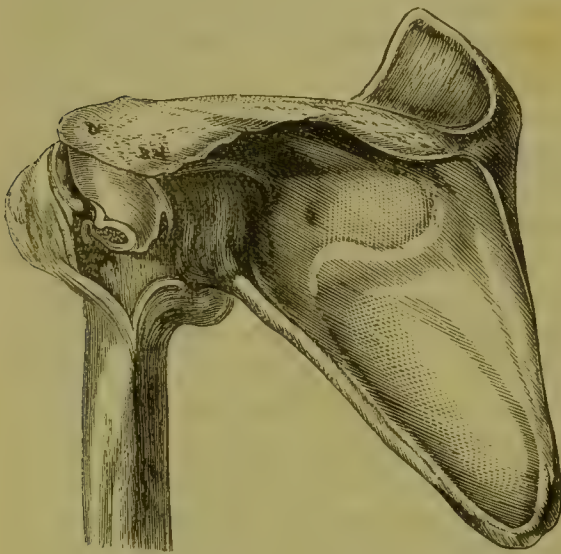


FIG. 81. Recent intracapsular fracture of the left humerus, seen from behind. The tuberosities separated from the head and shaft are divided into three fragments and driven outwards. The head, separated from the anatomical neck of the bone, is partly crushed. The shaft is driven upwards, and touches the lower part of the glenoid cavity. The capsule was intact, and has been opened in the dissection to show the fracture.—From Malgaigne's 'Atlas,' pl. v. fig. 1.



FIG. 82. Bony union of impacted intracapsular fracture of the humerus, five years after the occurrence of the accident.—From Prof. R. W. Smith, 'On Fractures,' p. 192.

fracture it is neither feasible nor desirable to disengage the fragments. The patient should be prepared for the loss of motion which will probably ensue, and passive motion should be employed to obviate this as far as possible. Gentle attempts to raise the shoulder should be made as early as the patient can bear them after the first three weeks.

2. The ordinary fracture of the neck of the humerus is the extracapsular or the fracture through the surgical neck, i.e. below the tuberosities. The arm is shortened; the lower fragment can be felt projecting into the axilla, where its sharp, irregular outline can easily be distinguished from the globular head of the humerus; the shoulder has not the pointed outline of dislocation; the arm is much more easily movable, and when its length

Extra-capsular fracture, or fracture of the surgical neck.

probability, that these extensive displacements of the upper fragment are effected gradually by the movements of the parts.

is restored crepitus will be felt. The upper fragment is usually tilted outwards by the muscles inserted into the great tuberosity (fig. 83); the displacement of the lower fragment inwards and upwards is due partly to the action of the force, partly to that of the flaps of the axilla and the muscles which pass from the scapula to the humerus below the fracture, and partly to the direction of the line of fracture. In some cases the lower fragment lies 'anteriorly externally, and even posteriorly,' as shown by Malgaigne, and it may be impacted in the tissue of the upper fragment.

This fracture is usually treated by the application of a case or splint of



FIG. 83. Fracture of the surgical neck of the humerus, with complete separation of the fragments. The fracture occurred in an old man *æt.* 77, who died twenty-six days after the fracture, which it had been impossible to reduce. The fracture was situated below the tuberosities and capsular ligament (which latter was nowhere opened), and about an inch above the insertion of the pectoralis major. The detached fragment was separated from the lower fragment and buried in the tissue of the upper. The upper fragment, free from any adhesion, had been drawn up by the supraspinatus, and probably by the other capsular muscles, into such a rotation upwards and outwards that the great tuberosity is buried under the acromion. In other words, the position of the upper fragment corresponds to that of the arm in its greatest elevation, and that of the lower fragment to that of the arm in its greatest depression. The dotted line shows the position that the lower fragment must have taken in order to bring the humerus into a line.—Malgaigne, *pl. vi. fig. 3.*

leather or gutta-percha moulded to the outside of the shoulder, and opposed by a large pad in the axilla, or a crutch similar to that used for fractures of the clavicle, or a splint about two feet long made of leather, bent in the middle to an acute angle, which is fitted into the axilla, while one limb of the splint rests upon the chest and the other supports the inside of the arm. The treatment of this fracture by a case of four straight splints, as for fracture of the shaft, is very ineffective, since all the splints will probably be found on careful examination to be placed on the lower fragment only. The same precautions should be adopted for avoiding stiffness of the

joint as recommended in the former case; but some loss of the power of elevating the shoulder is a very common result, and is usually attributed to inflammatory thickening of the lower portion of the capsule.

I have described these fractures separately from each other as purely intra- or extracapsular, but in practice there can be no doubt that they are often mixed, and what is called 'a fracture of the anatomical neck of the humerus' is really an injury in which the greater part of the line of fracture is external to the capsule, but a piece has been comminuted, or a subordinate line of fracture has run upwards into the joint. This is so in a preparation put up by Sir B. Brodie in St. George's Hospital Museum as 'fracture of the anatomical neck,' and the same was the case in a patient under my care, who presented the unusual complication of partial rupture and obstruction of the axillary artery, leading to gangrene of the arm and necessitating amputation at the shoulder-joint.

Separation
of the
upper
epiphysis.

3. Separation of the upper epiphysis is a well-marked accident, very clearly described by R. W. Smith, whose description I had an opportunity of verifying in the case which furnishes the accompanying figure (fig. 84). The patient is a young person below the age of 20, and usually much younger; the arm is neither lengthened nor shortened; the lower fragment projects somewhat inwards, causing 'a striking and abrupt projection situated beneath the coracoid process,' which Prof. Smith calls 'the most remarkable feature of this injury;' and this projection has not the sharp outline of an ordinary fracture, but 'feels rounded, and its superior surface is smooth and slightly convex.' When the injury is recent the lower fragment can be brought into its natural position, and then the prominence will be obliterated, and crepitus can be felt, though this may not be exactly the crepitus of fracture. The lesion may be treated by any of the plans which are used in other injuries about the same part, but the projection will probably remain permanently. There is, however, far less probability of loss of motion than in the fractures of adult life. The line of fracture, it must be remembered, is below the tuberosities, and the fracture is therefore mainly, if not entirely, extracapsular.¹ It seems to unite usually with but little inflammation.



FIG. 84. Separation of the upper epiphysis of the humerus. Taken from a boy æt. 15, under my care, in whom the diagnosis rested only on the symptoms during life. He recovered, with, I believe, complete use of the joint.—Holmes's 'Dis. of Childhood,' 2nd ed. p. 249.

Fracture of
the great
tuberosity.

4. Fracture of the great tuberosity is known by the increased width of the upper end of the bone, and the presence of a bony prominence below the acromion, which may possibly be made out as distinct from the head of the bone. The acromion is somewhat prominent, though less so than in dislocation, and the arm may be separated from the side, but can easily be brought back to it; and a thorough examination of the hand in the axilla will convince the surgeon that the head of the bone is in the glenoid cavity. There are cases, however, in which this fracture has occurred as a complication of dislocation (see fig. 95). If the separation be extensive and complete, the union may be ligamentous; in many cases bony union seems exuberant, and then considerable loss of motion will follow. Beyond keeping the parts at rest, and pressing the fragment and the head of the bone together by means of a pad in the axilla, opposed by a cap over the shoulder, I do not see what is to be done in the way of treatment.

Oblique
fracture of
the head
and shaft
of the
humerus.

In a paper by Dr. Ogston ('Lancet,' 1876, vol. i. pp. 420, 491), the reader will find an interesting series of cases believed to be instances of oblique fracture running downwards through the upper end of the humerus. Dr. Ogston believes (and certainly his cases render the conclusion difficult to resist) that besides the above-described fracture of the great tuberosity, 'there exist also cases where the articular portion of the humerus is detached in conjunction with the greater tuberosity (as asserted by Guthrie) by a fracture running obliquely downwards and backwards, the line of fracture occupying at its upper part the situation of the bicipital groove. The lower fragment

¹ R. W. Smith, 'On Fractures,' p. 203.

is formed by the shaft in conjunction with the lesser tuberosity. Such an injury is usually produced by a fall on the shoulder, and it exhibits characteristic symptoms. These are increased antero-posterior diameter of the shoulder; prominence of the lesser tuberosity at the anterior part of the shoulder, the prominence obeying all motions of the shaft; the existence of the head in the glenoid cavity, not moving with the shaft, save only to a limited degree, with very extensive movements of the arm; crepitus sometimes absent, best elicited by rotating the shaft or pushing it up and down in the direction of its long axis; powerlessness of the arm to the patient, but pretty free mobility to the surgeon; and a position of the arm not unlike that of a dislocation, but the elbow capable of being readily pushed into contact with the side. The shortening of the arm may be present or absent; it is present when the smaller tuberosity has pierced the fibres of the deltoid. The deformity cannot be entirely reduced, but the injury leaves a useful arm in spite of the deformed shoulder.'

'It is rather astonishing to find, in both series of cases, the marked impossibility of removing the deformity by any means whatever. In the present state of our knowledge on the subject it seems probable that this is owing to the *tendon of the biceps slipping into the cleft between the fragments.*'

Fracture of the shaft of the humerus occurs usually somewhat below the middle, though any part of the bone may give way. It is caused by any kind of violence, and sometimes by muscular action.¹

Fracture
of the shaft
of the
humerus.

The displacement varies with the direction of the line of fracture and other circumstances. Frequently it is not very much marked. There is seldom any difficulty in correcting it, or in procuring union without deformity. A case of four straight splints or a leather or guttapercha splint must be applied for about six weeks, when the fracture will be soundly united. The hand is to be carried in a sling, which should not be long enough to press the elbow upwards. Some surgeons prefer a rectangular splint, extending along the inner side of the limb, from the axilla to the fingers, and three short accessory splints, reaching from the shoulder to the elbow, in order to prevent any movements of the forearm, which they believe is the chief cause of non-union.

Fractures of the lower end of the humerus may be divided into: Simple transverse fracture above or below the condyles; fractures running between the condyles into the joint; fracture of either condyle; and separation of the epiphysis.

Of the
lower end.

The transverse fracture of the lower end of the humerus is of interest, inasmuch as it somewhat resembles dislocation. Both injuries are common in youth.² In the fracture the lower fragment along with the forearm is usually carried backwards, producing a projection behind the joint, and a prominence

¹ In fractures from muscular action, however, there is reason for suspecting in many cases that the bone may be diseased. Thus, a schoolmaster in striking a boy with his cane fractured the humerus. Some weeks afterwards (the fracture having in the meantime united) a tumour showed itself at the seat of injury, for which he became a patient at St. George's Hospital, where amputation at the shoulder-joint was performed. In other cases there is no evidence of disease; as in that of an Army surgeon, which a correspondent was so kind as to communicate to me, who broke his arm in throwing a cricket ball. The fracture united kindly, and he continued quite well. I once saw a case in which a strong healthy young man was said to have broken his thigh in walking across the room. The fracture certainly existed, and united in the usual period.

² In an interesting and, I believe, unique case recorded in the New York 'Archives of Clin. Surg.' vol. i. p. 333, the ulna (alone) was dislocated backwards, while the humerus was also fractured just above the condyles.

of the triceps tendon, as in dislocation; and there is a projection in front near the bend of the elbow, as in dislocation. Here, however, the resemblance ceases. In the fracture the parts can commonly be reduced and crepitus obtained. The projection in front is seen to be above the bend of the elbow, and to have a sharp outline, whilst in dislocation the prominence is below the bend of the elbow, and is rounded. But the most unfailing distinction is, that the measurement between the olecranon and internal or external condyle is natural in the fracture, while in the dislocation it is much increased. However great the swelling may be, one or other of the condyles can almost certainly be made out. In some cases, especially when the fracture is caused by a direct blow, the displacement of the lower fragment may be forwards,¹ in which case there can be no difficulty in diagnosis.

The separation of the lower epiphysis of the humerus is difficult to distinguish from this injury, though it occurs lower down. In this fracture either the whole epiphysis, or, as Dr. R. W. Smith thinks, only the part which forms the trochlea and capitellum, is separated from the shaft of the

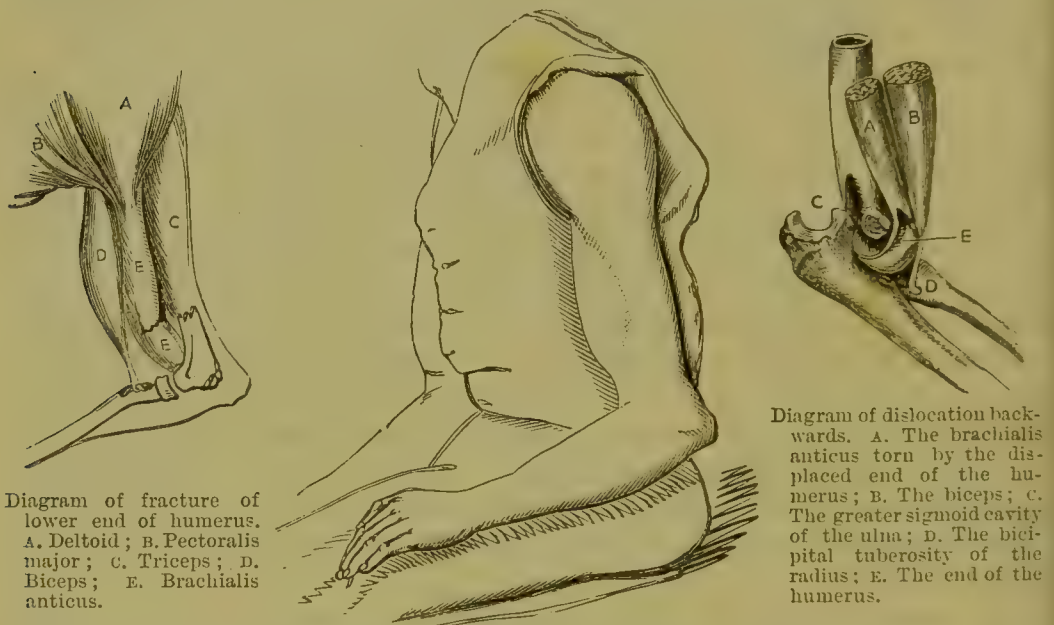


FIG. 85. Diagrammatical representation of fracture of the lower end of the humerus, contrasted with dislocation of both bones of the forearm backwards. The figure (from Liston) shows the general features of dislocation.

bone and carried backwards with the forearm.² Prof. Smith states that the lower epiphysis of the humerus is placed entirely below the condyles, and therefore describes the separation of the epiphysis as being necessarily 'infracondyloid.' This is certainly incorrect, as I have shown elsewhere, and as the annexed figures prove. The condyles are epiphyses as well as the trochlea and capitellum, and form pieces, though detached pieces, of the same epiphysis, as is correctly described in the ordinary anatomical works. At the same time it is quite possible that in separations of the lower epiphysis only the part which belongs to the trochlea and capitellum may be broken off, leaving the condyles attached to the shaft of the bone, but I am not aware of the existence of any preparation showing this form of fracture. We may conclude, then, that fracture may occur at any age, through the lower part of the shaft more or less close above the condyles; and at early periods the whole epiphysis may be separated, including the condyles, or only its infracondyloid

¹ See a preparation in the Museum of St. George's Hospital, Ser. i. No. 97.

² 'Brit. Med. Journ.' Aug. 17, 1867.

part. Thus there would be three forms of transverse fracture of the lower end of the humerus: 1. Supracondyloid; 2. Disjunction of the entire epiphysis; 3. Partial disjunction, or infracondyloid.

Stated shortly, the signs of these three fractures, as they are commonly seen, would be as follows: (a) In front of the joint. In the common fracture of the lower end of the humerus (displaced backwards) the lower end of the upper fragment projects in front and above the bend of the elbow; so it does in the other two fractures; but in the infracondyloid fracture the projecting part is wider, equal in breadth to that of the opposite humerus from one condyle to the other; and if the swelling is not too great the condyles can be made out as forming a part of it, while in the disjunction of the entire epiphysis the condyles will remain attached to the lower fragment, and the upper fragment will therefore be higher and less broad. (b) Turning to the back of the joint, two prominences are seen, one external, the other internal, in all three forms of fracture, as well as in dislocation. In all these injuries

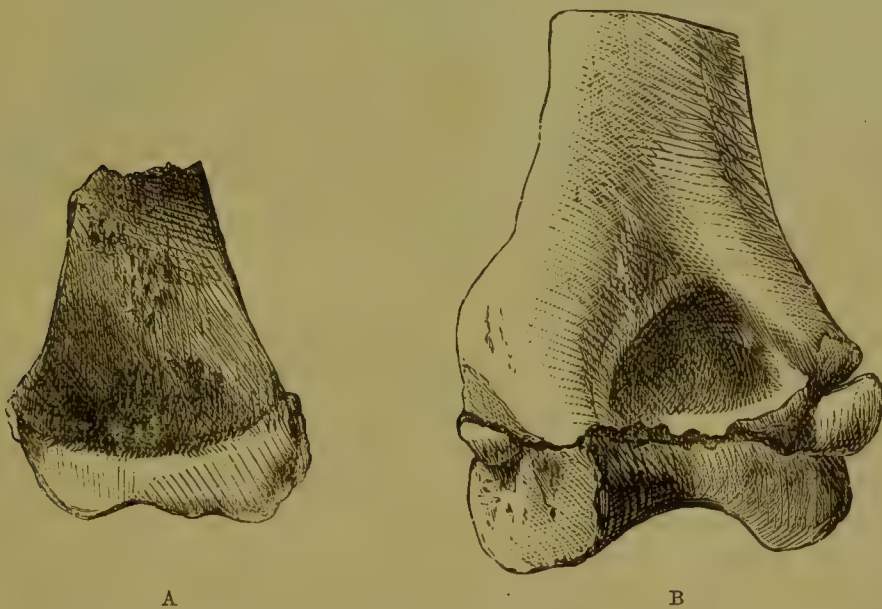


FIG. 86. Two figures to show the position of the epiphysial line in the lower end of the humerus, A, in early infancy, B, at the age of fifteen, showing that in early life all the part which afterwards forms the condyles is cartilaginous, and that subsequently the condyles, though they are formed distinct from the articular end, are also epiphyses. A fracture might, therefore, either separate them from the shaft, along with the epiphysis, or, on the other hand, separate the bulk of the epiphysis, and leave the condyles attached to the shaft.—From Holmes's 'Surgical Dis. of Childhood,' pp. 251, 252.

the two prominences are on different vertical levels, the internal (which in all of them is formed by the displaced olecranon) being the higher. The external prominence in dislocation is formed by the head of the radius, and is therefore far more remote from the internal than it is in any of the fractures¹ in which it is formed by the part of the humerus carried backwards with the radius, viz. the capitellum only in the infracondyloid fracture, the capitellum and external condyle in the disjunction of the entire epiphysis, and probably some part of the external condyloid ridge of the humerus, in addition to the condyle in the common supracondyloid fracture. In all four forms of injury the forearm is generally flexed, and the hand midway between pronation and supination.

The other fractures which communicate with the elbow are often com-

¹ Professor Smith says that in dislocation the vertical distance between the two prominences averages one and a half inch, while in infracondyloid fracture it seldom exceeds three-quarters of an inch.

T-shaped fractures and fractures of either condyle.

minuted. Some are of a T-shape, consisting of a transverse branch above the condyles and a vertical one between them, the condyles being movable on each other with crepitus, and the end of the bone increased in width. Others are mere linear fractures running from the outer or inner side of the bone into the joint, so as to separate the external or internal condyle. It seems that the prominent extremity of the latter portion of the bone may be separated from the shaft without implicating the joint.

The treatment of all these injuries is the same. The elbow must be bent to something above a right angle, so that if ankylosis should unfortunately occur the hand may be in good position. This position may be maintained by an angular splint in the bend of the elbow; or if there is any strong tendency to displacement of the lower fragment backwards the angular splint may be applied behind, while a straight splint is put in front of the arm to push back the upper fragment. After the end of three weeks passive motion must be sedulously made, the splints being removed and reapplied daily. Dr. Hamilton even recommends the total disuse of splints after the first seven days in fractures of the elbow, and the persevering use of passive motion daily, remarking, that 'though at this time no bony union has taken place, yet the effusions have somewhat steadied the fragments, and the danger of displacement is lessened, while the prevention of ankylosis demands very early and continued motion.' This, however, does not of course apply to fractures which are entirely above the condyles, but only to those in which the elbow-joint is clearly implicated.

We must now speak of fractures of the forearm.

Fracture of the olecranon.

The olecranon process is usually fractured by a fall on the elbow, but sometimes by muscular action. The fragment is generally drawn upwards by the triceps muscle, though if the periosteum and the fibrous expansion around the bone is not broken there may be no separation. Bending the forearm will make the interval more distinct, if there is any difficulty in detecting it, which, however, is rarely the case. The loss of the power of extending the forearm is sometimes complete—more commonly the patient can perform this action, though with pain and difficulty. Effusion into the elbow-joint generally occurs quickly, for the fracture almost always implicates the joint. It is said, however, that in rare cases only the tip of the process is broken off and the synovial membrane left intact.

This fracture often unites by ligament only—but also by bone—and then frequently with obvious evidence of inflammation (fig. 87). The joint is often left with hardly a trace of injury to its functions. This will necessarily depend in a great measure on the closeness of apposition of the fragments, but also on the avoidance of subsequent inflammation, and it is to these two indications that the treatment should be addressed. The first thing is to relax the triceps muscle completely by putting the arm in complete extension on a long splint reaching from near the shoulder to the palm, leaving the fracture uncovered. One of the plans used in fracture of the patella may be employed here also to draw the movable fragment downwards. Inflammation must be combated by cold, evaporating lotions, and leeches. At the end of about two weeks it is better to change the position of the forearm, so that if ankylosis results the limb may be in the most favourable position for the future welfare of the patient. In order to do this it is advisable to administer an anæsthetic, and, with the thumb firmly pressed on the top of the olecranon, to gently flex the forearm and put the limb up

on an angular splint. With care this little proceeding can be accomplished without any separation of the fragments, and it places the patient in a much more favourable position should any stiffness of the joint remain as the result of the injury. In ordinary cases the splint should be removed after a month, and passive motion be made daily, with great care at first, so as not to rupture the newly formed union.¹

As in fracture of the patella so in that of the olecranon, when the union has failed and the limb is thereby rendered useless, it is quite justifiable to cut down (with antiseptic precautions) and unite the fragments by suture. An interesting example of the success of this operation is recorded by Sir W. MacCormac in the 'Clinical Society's Trans.' vol. xiv. p. 210.



Compound fracture of the olecranon.

When the fracture is compound, the best plan of treatment is to wash out the joint thoroughly with some antiseptic lotion, so as to remove all foreign bodies, clots of blood, &c., wire the fragments together, provide for drainage, and dress antiseptically. If the wound is small and uncomplicated it may be possible to preserve the motion of the joint, otherwise ankylosis will occur, and therefore the forearm should be put up in the flexed position.

Fracture of the coronoid process occurs as a complication of dislocation of the elbow, and is treated of under that head (see fig. 99, p. 280). It is also

Fracture of the coronoid process.

spoken of as a separate injury, but I am not aware that its existence as such has ever been proved by dissection.² It is said to unite usually by ligament, in consequence of the displacement of the fragment by the brachialis anticus. The treatment would, therefore, consist in keeping the forearm fixed in the bent position for about three weeks, should this injury be diagnosed.

Fracture of the head and upper part of the radius occurs as a complication of dislocation (q. v.), and has sometimes been found as a complication of other injuries to the joint, such as compound fracture or gunshot wound. The cases which have been recorded and figured have been either longitudinal fissures extending downwards from the articular surface, or comminuted fractures in which the bone has been more or less shattered.³ As a substantive injury little is known about it, and its existence is generally unrecognised till after dissection or excision. I incline, however, to agree with Dr.

Fracture of head of radius.

¹ In this fracture also Hamilton is in favour of making passive motion daily from about the seventh day.

² Perhaps this statement ought now to be modified. Mr. Wainwright has recorded an interesting case in 'Clin. Trans.' vol. xix. p. 332, in which the coronoid process was fractured and the head of the radius split vertically; but there was no dislocation. As the motion of the elbow was nearly lost the fractured bones were excised, three months after the injury.

³ See a paper by Dr. Hodges, 'Boston Medical and Surgical Journal,' Jan. 18, 1877.

Hodges in believing that it is probably more common than is usually supposed.

Of both
bones of
the fore-
arm.

Bending of
bones in
childhood.

The most common fracture of the central part of the forearm is that in which both bones are broken, which usually occurs about the middle, though, as the fracture is generally caused by direct violence, any part may be broken; and I have seen cases where from the passage of a wheel over the limb the bones have been splintered into a great number of fragments. In children the fracture is often incomplete, being marked by a mere bending of the bones, with no crepitus, the upper part sharing in any movement impressed on the lower (see Greenstick Fracture, p. 122). The displacement in fracture of both bones of the forearm is often very considerable when the fracture is very oblique or much comminuted, but there is not in general any serious difficulty in getting the bones back into position. Nor is the treatment generally unsatisfactory even in somewhat complicated cases. There are, however, a certain number in which the power of rotation of the hand is more or less lost, a result which is ascribed by Mr. Flower¹ (following Lonsdale in this particular) to the fact that the two portions of the radius have been put up in different positions as regards supination. There are also more numerous instances in which some amount of deformity is left after union, but without any loss of motion. The indications are to keep the fragments from falling together, i.e. to obviate any tendency of the fragment of the radius to point towards the ulna, or *vice versa*, and to see that the natural line of the superficial portions of both bones is completely restored. For the former purpose it is desirable in complicated cases to place a graduated compress in the interosseous space. With regard to the latter, the defect alluded to by Lonsdale and Flower of putting up the two parts of the radius in different positions of supination is most surely avoided by the completely supine position of the whole forearm. This, however, is more irksome to the patient than the half-supine position. The latter is generally adopted, and answers well for all ordinary cases. The splints in general use are two straight well-padded wooden ones, at least as broad as the limb, and extending from the elbow to the wrist, on the back and front; or a paste-board, leather, or starched case may be applied at once. The bones should be kept in apposition for a month, care being taken to give passive motion to the fingers if they seem inclined to stiffen.

Fracture
of ulna or
radius only.

The ulna or radius alone may be broken in its centre. The ulna can only be thus fractured by direct violence, and this is also the cause of fracture of the shaft of the radius in almost all cases, since the result of a fall on the hand if the radius gives way is almost always Colles's fracture. Here also the great point is to see that the fragments do not fall towards the other bone, and for this purpose to thrust them out if necessary by a pad in the interosseous space. The sound bone, acting as a splint, will in all probability prevent any displacement, and no lasting effects need be apprehended.

Colles's
fracture of
lower end
of radius.

Colles's fracture,² or fracture of the radius close to its lower end, is a very frequent consequence of falls on the palm of the hand, especially in old persons. It is one of the few fractures which are believed to be more common among women than men, and it is very liable to be followed by a considerable amount of stiffness of the wrist and fingers, due in part, very likely, to a tendency to rheumatism in the patient. The radius is broken generally about

¹ 'Syst. of Surg.' 3rd ed. vol. i. p. 963.

² Mr. Colles's description of this fracture will be found in the 'Ed. Med. and Surg. Journ.' April 1814; or in the recent edition of his works by the New Syd. Soc.

an inch or a little more above its lower end, but sometimes much nearer the wrist, as in fig. 89.¹ The displacement which usually accompanies this injury, and which is so characteristic of it that it enables a surgeon to recognise it at a glance, is well shown in fig. 88, taken from Prof. Smith's work. The lower end of the radius carrying the hand is driven backwards and outwards, causing a deviation of the hand from the axis of the limb, a prominence of the styloid process of the ulna, a projection on the back of the forearm just above the wrist, and a corresponding projection on the front at a somewhat higher level caused by the flexor tendons being put on the stretch in passing over the upper fragment, which is usually displaced considerably forwards and inwards (see fig. 89). The power of pronation and supination is lost. If the hand can be restored to its natural position, crepitus will be felt on rotation. The line of fracture is usually nearly transverse, rarely so oblique as to allow of very great displacement, which, indeed, is impossible so long as the ulna and the internal lateral ligament of the wrist-joint remain entire. Much difference of opinion prevails as to whether this fracture is frequently impacted or no. It is believed to be so by most English and French authors,² and the appearance of fractures which have been long united with some amount of displacement certainly bears a close resemblance to the appearance of old impacted fracture. But the Irish surgeons, and notably Prof. R. W. Smith and Dr. Gordon, deny that impac-

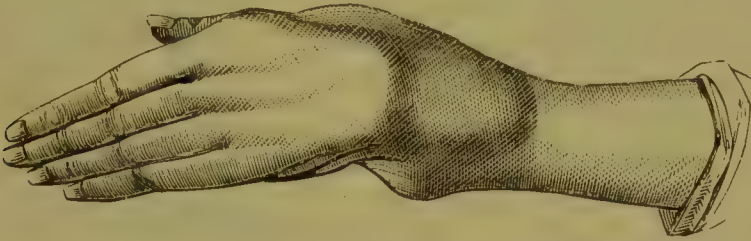


FIG. 88. Colles's Fracture, showing the most common deformity.—From Professor R. W. Smith, 'On Fractures,' p. 137.

tion is common; and they attribute the appearance referred to not to penetration of the lower fragment by the upper at the moment of the accident, but to subsequent inflammation which has produced an irregular callus encircling both fragments. There is no doubt, however, that in many cases there is an almost insuperable difficulty in disengaging the fragments, which can hardly be accounted for except on the theory of impaction, and for myself I certainly hold the general view.

The cause of the difficulty often experienced in reducing this fracture has been variously explained—and it is a matter of more than theoretical interest, since the method of reduction adopted will to some extent vary with the views the surgeon entertains as to the obstacles to reduction. That impaction is a

¹ Mr. D'Arcy Power has pointed out that in a large number of cases of 'Colles's fracture' the lower fragment of the radius is split by one or more fissures, which extend into the joint.—'Path. Soc. Trans.' vol. xxxviii. p. 250.

² The testimony of eminent pathologists leaves no doubt, to say the least, of the occasional occurrence of impaction of the upper fragment into the lower. See Callender, 'St. Bartholomew's Hospital Reports,' vol. i. p. 283, where three cases are related, in which, the patient dying on the spot from other injuries, this impaction was found. Another typical instance of impaction is related in the 'Annals of Anatomy and Surgery,' Brooklyn, March 1881, p. 117, where the upper fragment was so firmly impacted in the lower as to have crushed its spongy tissue to such an extent that the two fragments no longer fitted each other on reduction, and some permanent flattening of the anterior curve of the bone must necessarily have remained.

frequent obstacle I myself have no doubt. This must be combated by judicious extension and pressure applied to the fragments under anæsthesia. The action of muscles has been invoked in this as in all other fractures, and many eminent surgeons believe that the supinator longus or the pronator quadratus oppose reduction. This seems to me improbable, but in any case would be easily remedied under anæsthesia. Some authors believe that the tension of the untorn periosteum on the dorsal face of the fragment often opposes reduction. This membrane will be relaxed by extension applied with the hand in the hyper-extended position, a manœuvre which should always be adopted when other means fail. Lastly, it has been taught that the main obstacle is the implication of the displaced head of the ulna in the annular ligament and tendon of the Flexor carpi ulnaris, and that this displacement must be remedied before the fragment can be returned to its actual position.¹

In an elementary work of this kind it would be out of place to enter into any prolonged theoretical discussion as to the exact mechanism of this injury. I will content myself with quoting the following summary by Dr. Pilcher, of Brooklyn, of a paper on this subject in the 'Annals of Anatomy and Surgery,' March 1881.

'Fractures of the lower end of the radius may be produced: 1. Simply by the direct transmission of force through the carpus, longitudinal fissuring being the result; 2. Simply by avulsion through the forcible distension of the anterior ligaments, transverse fractures resulting. When comminution of the lower fragment is present, it may be the result of the wedge-like action of the carpus driven up against the articular face of the radius by direct force, fissuring it, followed by the avulsion of the lower part of the radius through distension of the anterior ligaments, this being the most frequent mode of its production; or by the splitting of the lower fragment through the descent into it from above of the upper fragment, a comparatively rare occurrence.'

The treatment is very often not entirely successful either in restoring the shape of the parts or the movements of the wrist and fingers, though the latter may be trusted to improve gradually. It is well to warn the patient of this. Several plans are in common use. Some surgeons use two straight splints, anterior and posterior, not reaching much beyond the wrist, and when these splints are used the surgeon generally draws the hand towards the ulnar side by means of the bandage which fixes the splint, or by a webbing strap. Nélaton's pistol-shaped splint is a very common apparatus, applied either to

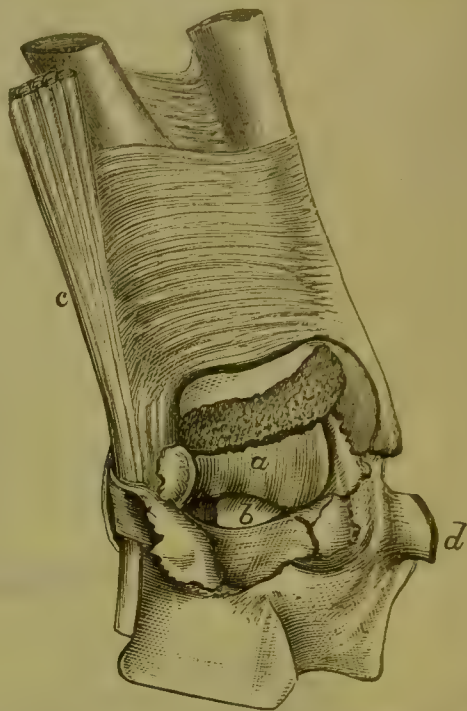


FIG. 89. A recent specimen of Colles's fracture, from the body of a boy who died of other injuries. *a* shows the fracture. The upper fragment is displaced considerably inwards and forwards. The lower fragment (between *a* and *b*), which is very small, remains in place, but can be displaced forwards by placing the hand in the position commonly assumed in this injury; *b* shows the wrist-joint; *c* the extensor ossis metacarpi pollicis; *d* the flexor carpi ulnaris tendon cut short.

¹ I would refer the reader to an interesting paper by Dr. Packard in the 'Am. Journ. Med. Sc.' Jan. 1879, to one by Dr. MacLeod in the 'Brit. Med. Journ.' July 12, 1879, and to another by Prof. Bennett in 'Brit. Med. Journ.' May 22, 1880.

the front or, as is perhaps better, to the back of the forearm and hand, with a short splint on the palmar aspect of the forearm.

Dr. Gordon¹ teaches that in this fracture both the fractured ends are displaced forwards, and this I believe to be true, since the backward displacement of the hand must tilt the upper end of the lower fragment forwards. Thus the natural concavity of the front surface of the radius is lost. It is to the restoration of this concavity, i.e. to the correction of the forward displacement of the two fractured surfaces, that the surgeon's efforts are to be directed. Dr. Gordon also follows Prof. R. W. Smith in denying the existence of impaction as a common condition. The means by which he proposes to remedy the

displacement, or to restore the natural concavity of the radius anteriorly, consist in first reducing the fracture by traction on the hand and pressure on the fragments, placing the hand in the prone position, then, applying to the anterior surface of the forearm a splint (fig. 90 A) to which a wooden conical or triangular piece (fig. 90 c) is so attached that the external border of the splint projects beyond it; and on the back of the forearm a straight splint (fig. 90 B) more thickly padded over the wrist than over the forearm. The splints are

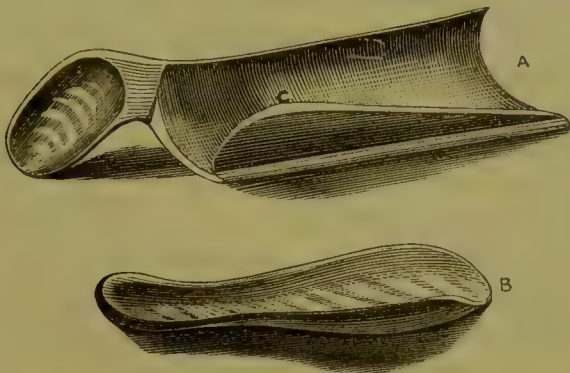
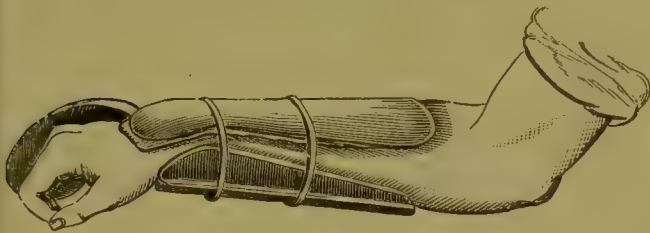


FIG. 90. Gordon's Splint, for fracture of the lower end of the radius.



The splints applied.

to be fixed by two webbing straps, not by bandage. The triangular bevelled end of the anterior radial splint lifts up the lower end of the upper fragment of the radius, the pressure made by the straps (which is thrown entirely on the ulnar side of the limb in consequence of the projecting border of the radial splint) remedies the projection of the ulna inwards, and the depression of the hand elevates the lower or carpal fragment and raises it to the level of the upper fragment. Those who have tried this plan adequately report in high terms of its results,² and a somewhat similar plan is said³ to have been employed by Sir P. Crampton.

I have used all three plans; Dr. Gordon's, indeed, only in one or two instances, but in one of these with great success. My own impression is that all methods give a good result in non-impacted fractures which can be and are accurately set at the time of the injury, and where the patient is healthy and tractable; and even when some deformity remains the movements of the wrist and fingers are preserved if timely passive and active movement are insisted on. Dr. Gordon seems to me to have somewhat exaggerated the frequency of the ill-success which, however, does undoubtedly sometimes attend the common methods of treatment.

¹ 'On the Treatment of Fractures of the Lower Extremity of the Radius,' Belfast, 1862.

² See Porter, 'Dublin Quart. Journ.' May 1865.

³ Ibid. Feb. 1862.

Another splint which seems now coming into use in this fracture is Carr's, which is intended to fulfil somewhat the same indications as Gordon's. It consists of two pieces, palmar and dorsal. The palmar splint is padded so as to form a convexity which may fill up and support the concavity of the radius. An oblique round cross-piece or bar ends the splint, which is to be fitted exactly under the metacarpo-phalangeal articulations, sloping therefore from without inwards and backwards. The patient's arm is secured to this splint by one or two turns of bandage, and his fingers are made to grasp the bar. In doing this, most fractures are reduced; or, if it is preferred, the surgeon may reduce the fracture before applying the splint. A thin dorsal splint is then applied. The advantages claimed for this splint are, that it enables the patient to move his fingers and thumb and thus avoids stiffness, and that it secures a better position for the fracture. In the 'Brit. Med. Journ.' April 9, 1881, p. 560, will be found an account of some cases under Mr. Heath's care treated with success with these splints, and its use at St. George's Hospital has also been satisfactory.

Whatever treatment is adopted, the part should not be kept too long stiff; the position of the parts should be verified at frequent intervals, and after about three weeks the limb should be taken out of the splints, and careful passive motion given to each finger-joint and to the wrist, the limb being first well steamed.

The lower end of the radius is also in rare cases comminuted or fractured in such a direction that its lower fragment is displaced forward, and sometimes the lower ends of both bones are crushed. Such accidents should be treated on simple straight splints, after careful reduction. When comminuted fracture affects both bones they are very liable to be soldered together in the process of union, causing entire loss of the rotatory movements of the hand, and the surgeon must combat this tendency as well as he can by timely motion.

Fractures
of the
carpus.

Fractures of the carpal bones are rare, at least they are rarely diagnosed—being possibly in many cases masked by the injury to the soft parts, which is usually severe. The accident in itself is not a very formidable one, for two or more of the carpal bones may be ankylosed together without any loss of the functions of the hand. I have seen a case in which, after a severe crush of the wrist accompanied by fracture, the greater part of the semilunar bone became loose and was removed, but the patient recovered with a very useful hand. Rest on a splint and cold lotion till the movements of the hand are no longer painful, followed by careful passive motion if necessary, comprise all that is required in the way of treatment.

Fractures
of the
metacarpus
and pha-
langes.

Fractures of the metacarpal bones and phalanges are generally the result of direct violence, though any of these bones (at least any above the terminal phalanges) may be fractured by a blow or a pull upon the finger. When a metacarpal bone is broken, the nature of the injury is at once declared by the dropping of the knuckle, and the break in the line of the dorsal surface of the bone. The treatment consists in bandaging the fist round a padded stick or a ball, or in putting the hand on a palmar splint which carries a pad of cork or other material, supporting the dropped knuckle at a proper level.

Fracture of a phalanx requires only a splint reaching into the palm of the hand, and keeping the finger perfectly quiet and straight.

Treatment may be given up in about three weeks in both cases.

Compound fractures in all parts of the upper extremity are very common

and are of far less gravity than the corresponding injuries in the lower limb. Gangrene also, if it occurs after the injury, is of less consequence to life, and secondary amputation much more likely to succeed. Much, therefore, is justifiable in the way of removing fragments, endeavouring to promote the union of wounds, and so saving the limb, which could not be allowable in compound fractures of the thigh, leg, and foot. Indeed, in the hand it is often better to allow the parts to slough away, and afterwards trim up the stump if necessary, rather than by primary amputation to sacrifice fingers, or parts of fingers, which may ultimately recover and prove very useful. Primary resections, also, which are so disastrous in the hip and knee, may be practised with good hope of success in the shoulder and elbow, and are perhaps preferable to the mere removal of splinters—operations which will most likely be followed by ankylosis, and involve probably the same risk to life as the more formal excision. This, however, does not apply, I think, to the wrist and the carpus, where the removal of fragments is less likely to impair the movements of the fingers, than excision of the whole articulating surfaces.

Compound fractures in the upper extremity.

In injuries of the hand, the thumb, or any part of the thumb, should be preserved in any condition, stiff or otherwise. Any portion of the metacarpus is useful if in connection with a thumb or movable fingers, since a very efficient apparatus can be fitted on to it. But if the flexor or extensor tendons of a finger are torn to pieces, or its joints destroyed, so that it must be stiff afterwards, it would only be in the way ultimately, and should be at once amputated.

The clavicle may be dislocated at either its sternal or acromial end, if we use the old nomenclature. It has now become more common to speak of the latter accident as a dislocation of the acromial extremity of the scapula.

Dislocation of the clavicle.

The sternal end of the clavicle may be dislocated forwards, backwards, or upwards. Dislocation downwards is impossible, on account of the first rib.

Dislocation forwards is the most common, though even this is a rare injury, for the sterno-clavicular, like some of the other joints, which in the skeleton appear very weak (for instance, the knee), is provided with so many and such powerful ligaments, and is so protected by the mechanism of the parts, that it is little subject to displacement. The force which would otherwise act on this joint is usually neutralised and resolved in the numerous and very powerful articulations through which it is transmitted, and when this is not the case it is generally expended in breaking the clavicle. When dislocation forward occurs, the head of the bone rests on the front surface of the sternum. The only ambiguity which can exist is between this injury and a fracture of the clavicle close to its sternal extremity; but the shape of the displaced head is generally quite characteristic; or in case of doubt measurement before reduction and examination afterwards will show in the case of fracture that the injured bone has not the length of the sound clavicle, and that crepitus is present. Reduction is usually easy, by drawing the shoulders backwards, but it is difficult to keep the parts in position. The arm must be put up, as in fractured clavicle, with the elbow carried farther forward than in the common fracture, or the hand may be bandaged on to the opposite shoulder. Nélaton prescribes that a truss shall be applied to press upon the displaced head. In the only case I have seen the displacement was not corrected, but the arm remained quite useful, and this is the ordinary event.

In the dislocation backwards the head of the bone is thrown between the sternum and the trachea, and sometimes produces the most alarming dyspnœa, or even death. It may be caused either by direct or indirect violence. The dyspnœa, the consequent bending forward, and to the affected side of the head (in order to make room for the displaced bone), and the changed shape of the parts leave no doubt as to the nature of the injury. In some cases the large vessels at the root of the neck are pressed upon, producing congestion of the head, and even semi-coma and absence of pulse in the upper extremity. Or if the dislocation occur on the left side, the œsophagus may be pressed on, producing dysphagia. Reduction is generally easy by drawing the shoulders backwards, and this position should be maintained by 'a splint passed behind the shoulders, with a pad between it and the spine, the shoulders being drawn to the splint by a bandage.'¹ After about a fortnight the splint may be withdrawn, and the patient kept quiet in bed till all tenderness and pain have subsided.

Dislocation upwards (suprasternal) is a rare injury, of which only about eight cases are on record. Its anatomy is now fully known, from a case which was carefully dissected and published by Professor R. W. Smith,² the man having died of other injuries. Dr. Smith's account contains two excellent drawings of the appearance of the part during life and of the dissected specimen. The head of the bone, carrying the interarticular cartilage with it, had been thrust between the two heads of the sternomastoid muscle, and lay in contact with the opposite clavicle. The sternohyoid muscle was behind it, the sternal tendon of the sternomastoid, tightly stretched over it, formed a considerable prominence during life. The rhomboid ligament was ruptured as well as the capsule of the joint. In this injury, treatment has hitherto been found unsuccessful in curing the displacement, but a good use of the arm may be anticipated.

Dislocation of acromial end of clavicle, or dislocation of the acromion.

Dislocation of the acromial end of the clavicle takes place usually in the upward direction, i.e. the clavicle lies upon the acromion process. If we follow the nomenclature of Messrs. Flower and Hulke we should call this a dislocation of the acromion process of the scapula downwards. It is believed to be caused in almost all cases by violence applied directly to the scapula, which is relatively by far the more movable bone.

The accident is unmistakable. The shoulder is depressed, the arm apparently lengthened; there is pain in raising the arm, voluntary motion is very limited, and the prominence of the acromial end of the clavicle is easily felt. The deltoid is considerably flattened, in consequence of the arm falling or being pressed downwards, by which the fibres of the muscle are pulled down. Reduction is not difficult. It is accomplished by drawing the shoulder back, while the dislocated end of the clavicle is pushed downwards; but the bones easily slip away again. The shoulder must be well raised, with a pad in the axilla, and a compress or truss placed on the outer side of the clavicle. Some little displacement will not seriously incommode the patient afterwards. The opposite dislocation, viz. that in which the acromion lies above the clavicle, is very rare. It must be treated on the same general principles.

As surgical curiosities, cases are spoken of in which the outer end of the

¹ See the account of a characteristic case by Mr. Hulke, in the 'System of Surgery,' 3rd ed. vol. i. p. 970.

² 'Dublin Journal of Med. Science,' Dublin, 1872.

clavicle has been thrown beneath the coracoid process as well as the acromion,¹ and cases in which the clavicle has been dislocated simultaneously from both its articulations.²

Dislocation
of the
shoulder.

Dislocation of the head of the humerus takes place usually in one of three directions—downwards, inwards, or backwards. A few cases of dislocation upwards have been described, and one of them was dissected by myself, but the injury is a very rare one.

The common dislocation is downwards, or into the axilla, but the position of the bone is not usually directly below the glenoid cavity, as would be inferred from Sir. A. Cooper's language, and as he no doubt believed, but rather internal to it, though still in the axilla, and somewhat below its natural level. Hence the dislocations into the axilla are divided into two varieties

—the *subglenoid*, or that directly downwards, and the *subcoracoid*, or that downwards, forwards, and inwards.

The latter is the common dislocation of the shoulder,³ the subglenoid being decidedly more rare. The dislocation inwards, 'below the pectoral muscle' of Sir A. Cooper, or 'subclavicular,' as it is now usually termed, after Malgaigne, and that backwards 'on the dorsum scapulæ,' or 'subspinous,' are very rarely met with.

There are certain symptoms common to all dislocations of the humerus, viz. a loss of the natural rounded shape of the shoulder, a change in the direction of the axis of the humerus, an increase amounting to between one and two inches in the vertical measurement of the

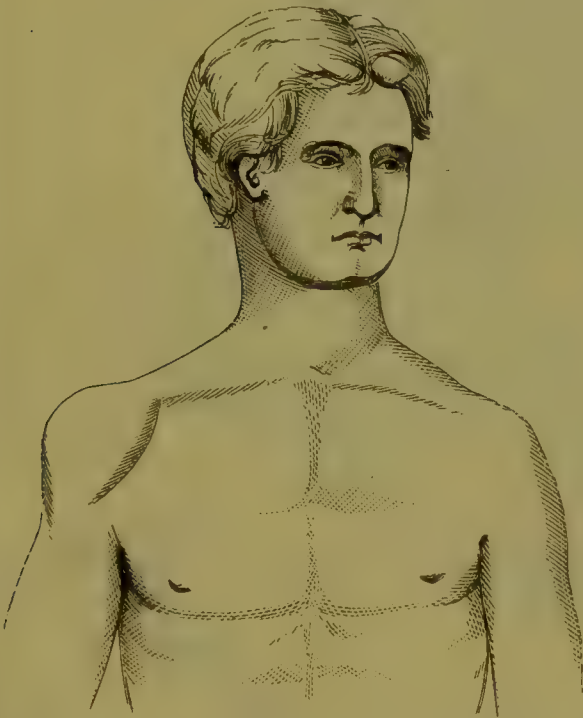


FIG. 91. Dislocation of the shoulder. An imaginary sketch, showing the usual appearance in the axillary dislocation. In the dislocation inwards, or beneath the pectoral muscle, the prominence of the shoulder will be more marked; and the head of the humerus will form a considerable prominence in the situation of the furrow between the deltoid and pectoralis major. —See A. Cooper, 2nd ed. pl. xxviii. fig. 42.

shoulder and axilla, loss of the power of voluntary motion, and resistance to passive movements in certain directions.

1. In the dislocations into the axilla the acromion is prominent and the deltoid flattened. The subcoracoid form of this dislocation is shown in fig. 92. The head of the bone usually lies immediately below the coracoid process in front, internal to, and rather lower than its natural situation. In other cases the head of the bone is thrown farther inwards, so as to rest more on the venter of the scapula than on the upper part of its neck, as it does in the usual subcoracoid dislocation (fig. 93). This is described by Malgaigne as a separate

1. Dislocation downwards, or into the axilla (subcoracoid and subglenoid).

¹ 'System of Surgery,' 3rd ed. vol. i. p. 972.

² For a list of these cases see Pick, 'Fractures and Dislocations,' p. 355.

³ According to Messrs. Flower and Hulke thirty-one out of forty-one preparations of dislocation of the shoulder preserved in museums, and forty-four out of fifty recent cases, were found to be of this form.

form, under the name of 'intracoracoid' dislocation; but I do not see any object in separating it from the other, and I much doubt whether the cases could be diagnosed from each other during life. Mr. Flower points out that



FIG. 92. Subcoracoid dislocation (after Flower).



FIG. 93. Intracoracoid dislocation (after Flower)

in old unreduced dislocations of the purely subcoracoid form the newly formed cavity for the head of the bone will trench on the old glenoid fossa, and will also be formed partly by the coracoid process, and that such specimens have often been described as partial dislocations. In the intracoracoid form the new cavity is independent of the glenoid fossa, and the coracoid process is not usually affected. In the subglenoid dislocation (fig. 94) there is a more considerable interval between the coracoid process and the head of the bone, which latter is also more prominently felt when the fingers are thrust into the axilla. In both forms the arm is directed away from the side, but more so in the subglenoid; ¹ it usually appears lengthened, and sometimes is really so, especially in subglenoid dislocations. In the



FIG. 94. Subglenoid dislocation (after Flower).

subcoracoid this elongation is usually proved by measurement to be only apparent, being due to the dropping of the affected shoulder; sometimes the arm is even shortened; there is often considerable pain from pressure by the dislocated bone on the nerves of the brachial plexus, especially the

¹ Mr. Hulke (op. cit. p. 978) refers to a very rare variety of subglenoid dislocation—*luxatio erecta*—in which the arm is pointed upwards.

circumflex, which in some cases is so much injured that the deltoid muscle does not recover its functions after the reduction of the dislocation; and in rare cases there is congestion or even œdema from pressure on the vein. The arm can be moved backwards and forwards, but cannot be lifted or brought to the side. The great tuberosity of the humerus is said to be often torn off, and sometimes drawn into the glenoid cavity.

The two forms of dislocation may be regarded as varieties of the same injury, in which the head of the humerus has been driven through the lower

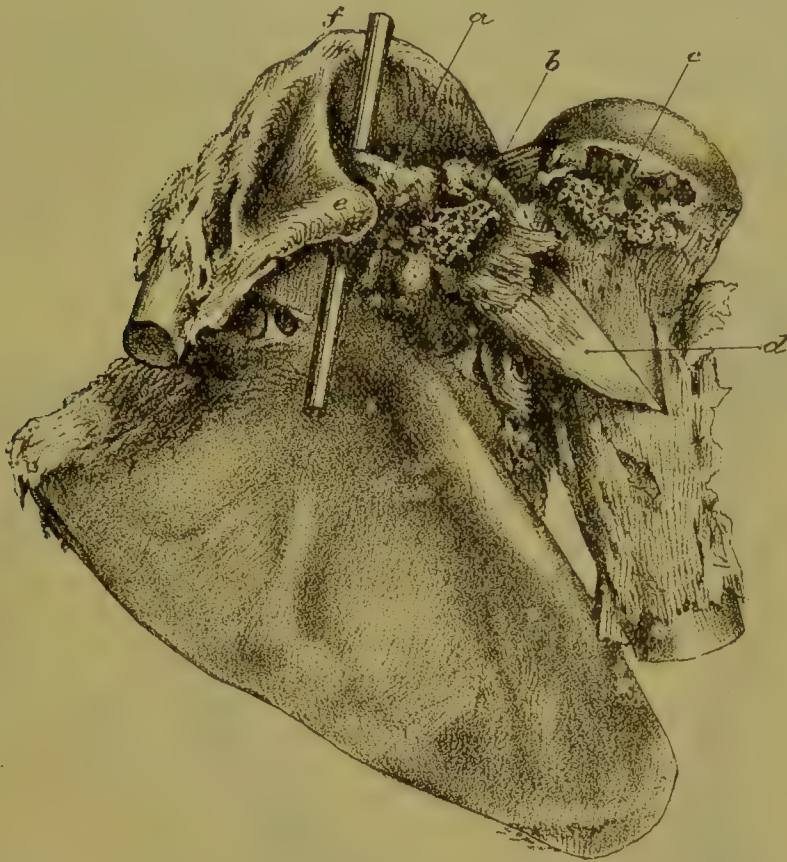


FIG. 95. Subcoracoid dislocation of the humerus with fracture of the great tuberosity. *a.* Tendinous structure, attached to the fragment of the great tuberosity. *b.* Long head of the biceps. *c.* Fractured great tuberosity. *d.* Periosteum of humerus, reflected. *e.* Coracoid process. *f.* Acromion. From a drawing by Hughes R. Davies, Esq. The patient was killed on the spot by a fall. The preparation is in the Museum of St George's Hospital.

part of the capsule, and in the subglenoid form has been arrested by the inferior costa of the scapula; while in the subcoracoid it has been drawn up by the muscles under the coracoid process.

The usual causes of dislocation into the axilla are either direct blows or falls on the shoulder, or a fall on the elbow or hand when extended, by which the lower end of the bone is violently raised and its head thrust against the lower part of the capsule. Muscular actions of the same kind (as in raising the arm to strike a blow) have been known to produce it, especially when the shoulder has been dislocated before. I have seen it produced (and for the first time) while the patient was lying in bed in the hospital.

2. In the dislocation inwards (subclavicular) (fig. 96) the head of the bone usually makes a considerable projection on the front of the chest, below the middle of the clavicle, and usually can easily be felt, though it is said that sometimes it lies deeply in the subscapular fossa. The head of the humerus cannot be felt from the axilla, though some part of the shaft may;

2. Dislocation inwards (subclavicular).

the arm is less separated from the side than in the axillary dislocations. The causes of this dislocation are the same; in fact, it is regarded as a variety of the common dislocation, in which from some unknown reason the head of the bone has been drawn farther inwards than in the ordinary subcoracoid dislocation. There can be no doubt, however, of the accuracy of Mr. Flower's opinion, that most of the cases described as 'dislocations beneath the pectoral muscle' would now be classed as 'subcoracoid.' The true subclavicular dislocation, in which the whole head of the bone lies internal to the coracoid process, is very rare.

3. Dislocation backwards (subspinous).

3. The dislocation backwards (subspinous) (fig. 97)¹ is a well-marked injury, in which the head of the bone forms a considerable prominence on the dorsum of the scapula, and a considerable depression is left beneath the coracoid process. The arm is usually rotated inwards, pressed closely to the side, and the elbow thrown forwards. It is caused by direct violence, or by falls on the elbow when advanced, or by violent twisting of the arm inwards.



FIG. 96. Subclavicular dislocation (after Flower).



FIG. 97. Subspinous dislocation (after Flower).

4. Dislocation upwards (supracoracoid).

4. The dislocation upwards (supracoracoid) can only occur after fracture of the coracoid or acromion process (usually the former); it is caused, I believe, always by direct violence, applied in the upward direction—the head of the bone lies in front of the clavicle, immediately under the skin.²

Diagnosis.

The rarer forms of dislocation of the shoulder present usually no difficulties of diagnosis; what follows, therefore, relates mainly to dislocations into the axilla, though here, again, the errors which are unfortunately common are more often the result of haste than of any real difficulty in the diagnosis.

The flattened shape of the shoulder and prominence of the acromion process are usually very characteristic of the injury, and so is the increase

¹ Some authors divide these backward dislocations into subacromial and subspinous, but the only difference is in the extent of the displacement, and the distinction seems superfluous.

² See my paper in the 'Med.-Chir. Trans.' vol. xli. p. 447.

in the vertical measurement around the armpit. Dr. F. Hamilton¹ has pointed out two diagnostic signs between dislocation and all the other injuries of the shoulder, which will be found useful in all cases where swelling is not very great. 1. If in the healthy state, or whenever the head of the bone is in the glenoid cavity, a rule be laid on the outer side of the arm, touching the elbow and shoulder, it will be distant from the acromion process at least half an inch, generally an inch or more. In any form of dislocation, on the contrary, the rule will touch the acromion. 2. If the surgeon stands behind the patient and places the forefinger and thumb on each side of the acromion process just external to the joint with the clavicle, the forefinger in front and the thumb behind, and then carries them vertically downwards, the tip of the finger will rest on the centre of the front of the rounded head of the humerus, while the thumb will also feel its posterior part, indistinctly at first; but if the elbow is thrown forwards and the arm rotated, the head of the bone will strike the thumb more plainly. This is the case when the head of the bone is in the socket; but if dislocation exists the head of the humerus cannot be felt by the thumb thus placed.

Cases occur in which, from paralysis of the deltoid muscle, the shoulder has the same shape as in dislocation; but when this is the result of infantile paralysis the history is different; and even when the paralysis follows on a dislocation (from lesion of the circumflex nerve) the surgeon may easily satisfy himself that the dislocation has been reduced, by the absence of any prominence in the axilla, by the freedom of passive motion, and by the vertical measurement round the shoulder—which in unreduced dislocation is greater than on the sound side—while in paralysis it is equal or less; and the same remarks apply to wasting of the deltoid after lesion of the circumflex nerve from other causes.

From fracture of the surgical neck of the humerus dislocation may be distinguished by the more pronounced flattening of dislocation, by the different shape of the bone which is felt projecting in the axilla, and by the crepitus which is felt in cases of fracture when the arm is reduced to its natural position, such reduction being usually very much easier in the fracture than in the dislocation, while the displacement is also easily reproduced. The higher up the fracture is, the more it is impacted, and the longer the time which has elapsed since the accident, the more difficult does the diagnosis become; nor is it always by any means easy to satisfy oneself whether there is some fracture of the glenoid cavity or neighbouring part of the scapula in cases which at first sight seem pure dislocations. The difficulty is increased by the effusion of lymph into the sheaths of the tendons and cavity of the joint which usually follows on unreduced dislocation, and which gives rise to a sensation of crepitus very hard to distinguish from that of fracture. There are few practical surgeons who have not had to confess the great difficulty of pronouncing a definite opinion in such cases.

The diagnosis may, again, be complicated by fracture either of the scapula or of the humerus. In a former section (page 251) I have discussed the question, raised by Sir A. Cooper, as to the probable frequency of fracture running through the neck of the scapula and leading to such displacement of the glenoid process along with the humerus as may simulate dislocation. But exclusive of such injuries, in which there is no dislocation, there can be no question that in some cases where dislocation does exist there exists also fracture of a portion of the glenoid cavity, or of the coracoid process, or of

¹ See 'London Med. Record,' April 21, 1875.

Dislocation complicated with fracture.

the great tuberosity (fig. 95), or possibly some other part of the upper end of the humerus. Dislocation, complicated with fracture of the glenoid cavity, will produce, as Malgaigne has shown, many of the symptoms which Sir A. Cooper attributed to fracture of the neck of the scapula; and it is, as far as I can see, indistinguishable from the fracture of the anatomical neck of the bone, described by Lotzbeck; but it does not separate the coracoid process from the rest of the scapula, and therefore may be distinguished (though not without difficulty) from the fracture of the surgical neck of the scapula which Sir Astley so clearly describes. Fractures of the coracoid process or of the great tuberosity produce crepitus, but do not cause that insecurity of reduction which is so marked a feature in fracture of the neck of the scapula, and in dislocation complicated with fracture of the glenoid process. The fracture in these latter cases is an unimportant complication, only necessitating longer confinement of the arm. When dislocation is complicated with fracture of the shaft of the bone the injury is a much more serious one, since reduction is often impossible; and the nearer to the joint the fracture is, the greater is the difficulty. Nor is it always easy to recognise the real nature of the injury at the time. Much care, therefore, ought to be bestowed on the examination of every case of fracture high up, in order to ascertain by careful exploration of the axilla that the head of the humerus is in its place. Should dislocation be detected the patient must be brought into a condition of complete anæsthesia, and all available means used to manipulate the dislocation into position. If this attempt fails, then the fracture must be set in such a position as will best restore the shape of the humerus; and in a month or six weeks, when consolidation seems to have far enough advanced, reduction must be attempted, much caution being, of course, observed not to re-fracture the bone.

Reduction.

There are numerous methods of reducing these dislocations, and those methods seem at first sight so different from each other as to lead the student to suppose that the force is applied in one in just the opposite direction to the other. For instance, in the common method, with the heel in the axilla, the arm is pulled directly downwards, towards the patient's feet, while in another method it is pulled directly upwards, above his head. But Mr. Skey¹ has shown that the mobility of the scapula to a great extent, at any rate, neutralises these differences, and that in all the plans of reduction the arm is pulled in a direction more or less perpendicular to the plane of the glenoid cavity.

The best plan, and the most usual one, is to place the patient in the horizontal position. The surgeon, sitting down on the edge of the bed or sofa on which the patient lies, puts his heel (unbooted, of course) into the axilla and presses the head of the bone upwards and outwards with it, while he pulls on the hand and wrist, slightly rotating the arm if necessary.² The dislocated bone generally goes in with a snap, and the natural appearance and mobility of the joint are at once restored. Recent dislocations are generally reduced easily enough, especially if the involuntary resistance of the muscles is obviated by calling off the patient's attention, or by making him believe that the proceeding is one of exploration only, when by a sudden movement the bone may generally be slipped back; but if the patient is unusually timid

¹ 'Operative Surgery,' 2nd ed. p. 105.

² If necessary, in old dislocations a jack-towel can be fixed on the arm, by a clove-hitch, above the condyles of the humerus, on which the surgeon and his assistants can pull. This is hardly ever required, however, in recent dislocations.

(and especially if it be a female), or a very muscular person, or if there is much pain in the part, or unsuccessful attempts have been already made, it is better to induce anæsthesia, which very much facilitates the proceeding.

Another and a very good method is to lay the patient flat on the floor, or with his head to the foot of the bed or sofa, stand behind his head, steady the scapula with one hand, and pull the dislocated arm in a line with the patient's body—i.e. in a direction which if he were standing would be vertically upwards; or to place the patient, sitting on the ground, in front of a chair or sofa, on which the surgeon stands and steadies the scapula with his foot, while pulling the arm vertically upwards.¹

Sir A. Cooper used sometimes to employ downward traction on the arm, the patient being seated in a chair, and the surgeon putting his knee in the axilla; but this method is much inferior to the two preceding.

Sometimes a sort of combination of these two methods succeeds at once, and with little or no pain or force. The surgeon steadies the shoulder with his left hand and supports the arm with his knee; while he raises, rolls inwards, and slightly pulls on the dislocated arm, pressing the head of the bone at the same time outwards and upwards with his left hand. The head of the humerus, thus disengaged from the scapula, will slip into its socket by the action of the muscles. Some authors speak of the efficacy of circumduction, 'the arm being made to describe a half-circle over the face and head;' and other surgeons describe the manipulation method somewhat differently.² Kocher³ describes a method of manipulation which is, I believe, the best in use. The proceeding is very simple, and may be thus described: The surgeon stands or sits beside his patient. The elbow is pressed to the side, the forearm flexed, and rotated outwards till it stands at right angles with the body. The head of the bone will then often roll into the glenoid cavity. If it does not, the elbow is to be raised, by flexing the arm to an angle of 45°, and then rotated inwards till the hand is brought to the opposite shoulder. Anæsthesia is required only in old dislocations or very nervous persons. The method is recommended by its author only in subcoracoid, but is equally efficacious in the subglenoid variety. For the theory of its action I must refer to Kocher's paper. It is a plan which is well worth trial, especially in cases complicated with fracture of the ribs or other injuries.

Reduction
by manipu-
lation.

Mr. Kelly describes, in the 'Dublin Journal of Medical Science' for September 1882, a method which he has found successful when others have failed. The patient is drawn to the side of a firm horizontal couch, with the dislocated shoulder on its edge; the surgeon, standing at his side, so that his own trochanter may be a little above the patient's shoulder, winds the arm round his own pelvis, fixing the hand by pressing it firmly against the crest of his ilium, and then twists half round, so as to turn his back to the patient. Of course the patient's body can be held or steadied if necessary.

Another and a very powerful method is thus described by Mr. Flower: 'The patient is seated on a high chair, which is placed about two feet from an open doorway. The surgeon, having his back against the doorpost, places one foot upon the side of the chair, and, with his knee pressed into the axilla, and both hands upon the shoulder, steadies the patient's body. A jack-towel

¹ See Lowe, 'St. Bartholomew's Hospital Reports,' vol. vi. p. 4.

² Bryant, *op. cit.* vol. ii. p. 328. Pirrie, 'Principles and Practice of Surgery,' 2nd ed. p. 319. Gordon, *op. cit.*

³ 'Trans. Internat. Med. Congr. 1881; Surgery,' p. 214.

is then fixed by a clove-hitch-knot to the patient's arm, just above the elbow; and by its means two or more assistants, placed on the other side of the doorway, make steady extension vertically outwards.'

Reduction
by pulleys.

As a general rule it is only in neglected dislocations that pulleys are needed.¹ The patient is brought fully under anæsthesia and placed either in the sitting or reclining posture, the body fixed to a firm staple on the side opposite to the dislocation by means of a leather bandage, which encircles the shoulder and fixes the scapula, its two ends being secured by a cord to the staple. The arm should be bandaged from the hand, and the pulleys attached to a leather collar fitted to the arm above the condyles of the humerus. Traction is made in the horizontal direction, with gradually increasing force, and when the surgeon finds that the head of the bone is moving he tries to manipulate it into the glenoid cavity. In cases of long standing it is well to begin by breaking down all adhesions, as far as possible; and if any tendons can be found on the stretch which seem to oppose reduction, they may be subcutaneously divided a few days before the attempt is to be made. Since the introduction of chloroform the limit assigned by Sir A. Cooper to the time at which attempts at reduction may be made has been much extended. That limit was fixed by him at three months; but cases have now been recorded in which reduction has been effected even as much as two years after the accident.² The propriety of such attempts must, however, depend in a great measure on the amount of inconvenience which the patient complains of. There can be no question that the necessary force cannot be applied without danger. The artery has occasionally been torn in reducing a dislocation, though, as Mr. Callender has shown,³ the cases of which we have a complete record are very few, and in a large proportion excessive violence was used by unskilful persons.⁴ The vein has also been ruptured—though this is even more rare—or the humerus fractured. It is true that these grave injuries are not common, especially when the patient is not advanced in age and the arteries are healthy, yet no one can have used or seen used the force which even prudent surgeons are obliged to employ in such cases without feeling that it must involve some risk of immediate danger or subsequent inflammation; and the consideration which Sir A. Cooper puts forward is a very grave one—whether the arm is really likely to be useful after reduction. It must be remembered that Sir Astley did not deny the possibility of reduction later than three months; he even says he had seen examples as late as six months; but he says 'the injury done in extension was greater than the advantage received from reduction.' And I would remark, that in the published accounts of cases of late reduction we are, as a rule, left quite in the dark on this head. It is, therefore, only in cases where the unreduced dislocation is a source of much misery to the patient that I should be disposed to make the attempt. After unreduced dislocation, as a general rule, the limb acquires very considerable usefulness—the patient regaining the power of raising the arm nearly to the

Limit of
time for
reduction.

¹ It may be well to remind the reader that in the system of pulleys in common use, where parallel strings pass round a number of pulleys, the force applied is multiplied by the number of strings on the block, or twice the number of the pulleys.

² See on this subject an interesting paper by Mr. Brodhurst in 'St. George's Hospital Reports,' vol. iii. p. 67.

³ 'St. Barth. Hospital Reports,' vol. ii. p. 96.

⁴ There seems no doubt of the truth of an account of a case which occurred in France a few years ago, in which an old woman's forearm was *pulled off* in an attempt to reduce a dislocation.

horizontal line; the parts accommodate themselves to their new position, and there is neither pain nor œdema. Sometimes, on the other hand, there is great pain and great loss of the use of the limb. In such cases it might possibly be justifiable to remove the head of the bone, and an interesting case in which subcutaneous section of the neck of the humerus was successfully performed by Dr. Ewing Mears, of Philadelphia, will be found mentioned by Mr. Adams in the 'Brit. Med. Journ.' Jan. 20, 1877.

After reduction the arm should be bandaged to the chest, the hand and forearm being kept inside the clothes, so that no movement is permitted; and it is well to place a pad in the axilla. After a week of this rigid confinement the surgeon should commence daily passive motion, moving the head of the bone in every direction, and the patient may be instructed to carry the arm in a sling for another ten days or a fortnight, and may then be allowed to make some use of it; but he should be careful to avoid violent or sudden exertion for a considerable time, at least a quarter of a year. Renewed dislocation is very common, and each time the joint is dislocated it becomes less secure.

Compound dislocation of the shoulder is a rare injury, and a very serious one. 'It still remains to be determined by experience,' says Mr. Hulke, 'whether under such circumstances reduction, or resection of the head of the bone, is the safer method of treatment.' My own feeling would be decidedly in favour of reduction in healthy persons, and in the absence of complications; but where the patient was weak or old, or the exposed bone injured, or the parts much lacerated, it would probably be better to saw off the exposed head of the bone. A good instance of the success of reduction is to be found in a case related by Mr. Holden in 'St. Barth. Hosp. Reports,' vol. xii. p. 41. The patient was 19 years of age. The head and neck of the humerus subsequently exfoliated, but the patient had a very useful limb. References to other cases will also be found in Mr. Holden's paper.

Compound
dislocation.

We do not know very much about partial dislocations of the shoulder. The case so frequently quoted, described by Mr. Soden of Bath,¹ as partial dislocation upwards, with rupture of the tendon of the biceps, was, there is every reason to believe, an instance of chronic osteoarthritis, supervening on a sprain. Such displacement and disappearance of the tendon is constant in that disease.² Mr. Flower and Mr. Hulke 'are disposed to agree with Dr. R. Adams in denying that the case of partial luxation of the head of the humerus, as the result of accident, has ever been satisfactorily proved, either in the living or the dead subject.' Mr. Le Gros Clark, however, has published a case of partial dislocation of the head of the bone backwards, which, I think, must be allowed to be conclusive. The patient, a spare, elderly man, had slipped in getting over a hurdle, about two hours previously. There was no effusion into the joint; the movements of the joint were almost lost; the head of the humerus was 'in its natural position as regards height, but its projection in front of the acromion was absent, and there was an abnormal prominence at the back of the joint, behind and below the acromion. On gently raising the elbow from the side and rotating the humerus, its head

Partial dis-
locations.

¹ 'Med.-Chir. Trans.' vol. xxiv. p. 212.

² See the criticism of Mr. Soden's case, by Dr. R. Adams, on 'Rheumatic Gout,' 2nd ed. 1873, pp. 140 et seq. The possibility, however, of displacement of the long tendon of the biceps is proved by a specimen in the Museum of St. Bartholomew's Hospital. See Chap. XXV., where the general subject of dislocation of tendons is treated.

slipped into the glenoid cavity with an audible click, and the joint at once resumed its normal form and appearance—the patient exclaiming that he lost his pain as soon as he felt and heard the bone go back.’¹ The thinness of the patient and the absence of any effusion left no doubt of the position of the bone; and since a week’s rest in a great measure restored the use of the joint, Mr. Clark concludes that there could have been no laceration of the capsule or tendons. The case, also, which is described by Mr. South² shows very plainly indeed the possibility of partial dislocation of the head of the humerus forwards, at least when, as in that case, the coracoid process is fractured—a condition which Mr. South regarded as essential to the occurrence of partial dislocation in this direction. In that case a depression existed behind and below the acromion, which led to the supposition that some displacement of the head of the humerus or fracture of the neck of the scapula existed, but still the roundness of the shoulder was not lost. On making certain manipulations the head of the humerus was felt to move backwards, and then the appearance of a pit ceased. The patient having died two days afterwards from the effects of other injuries, the head of the bone was found in its proper position; there was a rent or slit about an inch long in the capsular ligament, through which the cartilage covering the humerus was exposed. On lifting up the shaft and pressing the head of the humerus forwards it was seen to be ‘partially thrown forwards and over the front edge of the glenoid cavity, so that it became fixed, and behind it the depression below the acromion appeared, in consequence of the sinking of the tendons of the infra-spinatus and teres minor muscles into the glenoid cavity from the altered position of the head of the bone, which, however, did not protrude through the slit in the capsule, although it was there more distinctly visible.’

From these cases the conclusion would be that partial dislocation of the shoulder is, in itself, a trifling accident, easily remedied, and not liable to produce any permanent mischief; and that it is a very rare injury, though its occasional occurrence is undeniable; and very possibly it may be overlooked, from the head of the bone having slipped back before the patient is seen.

Dislocation
of the
elbow.

Dislocation of the *elbow* is a tolerably common accident, taking place usually in youth, as the result of a fall or wrench, or sometimes of a blow.

If diagnosed at once and properly treated, the injury is one in which a good result may be confidently expected. But it is singular how very often cases are met with in which the accident has been overlooked, and then the dislocation becomes rapidly irreducible. I cannot remember to have seen such a dislocation reduced after six weeks, and I have known cases in which mischief has been done by the attempt.³ In all injuries affecting the elbow the surgeon should study minutely the relations between the various prominences of the bones—viz. the internal condyle, olecranon, external condyle, and head of the radius—and should not affect to give a diagnosis until he has observed at any rate the following points: 1. Is there any transverse

¹ ‘St. Thomas’s Hospital Reports,’ New Series, vol. v. 1874, p. 145.

² ‘Med.-Chir. Trans.’ vol. xxii. p. 100. Dr. Stephen Smith, of New York, recently recorded two cases which he considers analogous to that of Mr. Clark’s patient. ‘New York Archives of Clin. Surg.’ i. 33.

³ Dr. Sayre relates two cases in which dislocations of fourteen and sixteen weeks’ standing were reduced by the aid of subcutaneous section of the triceps tendon. ‘Western Lancet,’ Jan. 1873.

fracture of the humerus? i.e. on grasping the condyles in one hand and the lower part of the shaft in the other, can they be made to move or crepitate on each other? 2. Is there any longitudinal or partial fracture of the lower end of the humerus? i.e. are the condyles unnaturally separated from each other, can they be made to crepitate when grasped by the finger and thumb of opposite hands and moved on each other, or is there a movable fragment of either (probably the internal) condyle without any fracture into the joint? 3. What is the distance between the olecranon and the internal condyle on the injured as compared with the sound side? 4. Is the olecranon itself fractured? 5. Does the head of the radius move with its shaft on passive rotation, and is it in the normal relation to the external condyle? 6. Do the axes of the two bones of the forearm correspond in direction? 7. Is the axis of the forearm natural, relatively to that of the arm?

I allow that in some cases some of these questions may not admit of an immediate answer, from the amount of swelling present, but usually they do, or at any rate the most important of them. If they do not, the diagnosis of the case should be deferred, and the surgeon should not be ashamed to say that he cannot at present tell what the nature of the injury is.

The commonest dislocation of the elbow is that of both bones of the forearm backwards. The radius and ulna maintain their normal relation to each other, the orbicular ligament remaining attached to the sides of the small sigmoid notch. The olecranon projects considerably; the arm is semi-flexed (see fig. 85, p. 258); the head of the radius may perhaps be felt at the usual distance from the olecranon; but the distance between the tip of the olecranon and the internal condyle very greatly exceeds that on the other side. There is a great rounded prominence in the bend of the elbow, or rather, perhaps, pushing the fold of the elbow downwards, so that the forearm seems shortened. There is commonly no crepitus; unless, perhaps, in some cases where the projection of the internal condyle has been chipped off.

Dislocation
of both
bones
backwards.

Most of these distinctive characters of the backward dislocation of the elbow can be clearly traced on fig. 98, taken from an injury of this kind which I accidentally found in the body of a seaman who died from a different cause.

By these signs the dislocation can be readily distinguished from the injury which most resembles it—i.e. a fracture of the lower end of the humerus just above the condyles, in which there is often displacement of the forearm backwards, with semiflexion, projection of the olecranon and tendon of the triceps, and a prominence near the bend of the elbow. But in the fracture, though the olecranon projects, measurement will show that it is at the same distance from the internal condyle as on the sound side—the prominence which is formed by the other fragment of the humerus is not in or below the bend of the elbow, but above it, and has not the rounded outline of the head of the bone. And the diagnostic sign on which Sir A. Cooper laid so much stress is of great value, that reduction, though easy, is very insecure, the displacement being immediately reproduced. Also when the parts are reduced crepitus may be felt. There is not, therefore, ordinarily any real difficulty in diagnosing the two injuries. (See p. 259 for a fuller account of the fractures near the elbow.)

Such are the symptoms and the pathological anatomy of the complete dislocation backwards. But from the less amount of flexion, and from the great ease with which reduction is effected, it is believed that in many dislocations the displacement is not complete—i.e. the coronoid process is not

carried fairly into the olecranon fossa, but rests on the trochlear surface, from which, of course, any slight traction will replace it into its natural position.

Dislocation, with fracture of the coronoid process.

Again, it is believed by many surgeons that this displacement of both bones backwards is often accompanied by fracture of the coronoid process of the ulna, as was the case in the remarkable pair of specimens one of which is represented in fig. 99. I am not prepared to speak confidently on this point. I have met with one case in which during life all the symptoms of the injury were very plain—dislocation of the bones backwards, very easily reducible, some crepitus after reduction, and constant reproduction of the displacement. But in ordinary cases the reduction when once effected is so secure, and passive movement of the ulna round the trochlear surface of the humerus after reduction is so smooth and uninterrupted, that it is difficult to believe in the existence of any such fracture. Nor is there any anatomical



FIG. 98. Old dislocation of both bones of the forearm backwards. From the body of a man who died from other causes. Nothing is known about the accident. *a* shows the olecranon process projecting, with *c*, the triceps muscle, attached to it. *b*, the radius, the head of which has formed a new articular cavity for itself on the back of the external condyle and enjoyed some little mobility. The coronoid process of the ulna was lodged in the olecranon fossa, and was almost immovable, so that there seems to have been no power of flexion and extension. *d* points to the biceps muscle, which remained attached to the radius. *c*, to the brachialis anticus, which had been torn away from the coronoid process. The principal part, here shown, was fixed to the humerus, so that its action had been abolished. Some fibres, however, were also attached to the ulna below its natural insertion.—From a specimen in the Museum of St. George's Hospital, Ser. i. No. 108.

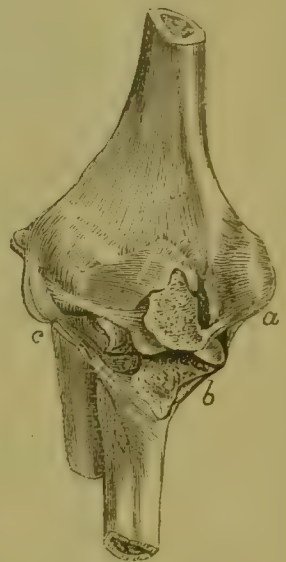


FIG. 99. Dislocation of both bones of the elbow backwards, with fracture of the coronoid process of the ulna. *a* shows the fragment of the coronoid process, which remains connected to the humerus. *b*, the surface of the ulna, from which it has been separated. *c*, the upper end of the radius displaced backwards, as was also the ulna. A vertical fracture traversed the head of the radius. The specimen in the Museum of St. George's Hospital (Ser. i. No. 111) was taken from the body of a man who, while at work on some repairs in the hospital, fell from a great height into the courtyard, and was taken up dead. There was exactly the same injury of the elbow on both sides, even to the longitudinally splitting of the head of the radius, showing that he must have come down with both hands on the ground in precisely the same position.

confirmation of the doctrine which affirms the frequency of fracture of the coronoid process, as far as I know.

Reduction.

If dislocation backwards remains unreduced it leads to very lamentable loss of the motion of the arm. In the preparation, fig. 98, there remains no movement of flexion and extension whatever, the coronoid process being wedged into the olecranon fossa and tightly bound down there by inflammatory adhesions, the brachialis anticus torn away, and the biceps having no means of acting on the radius, which is itself firmly attached to the ulna. All that the patient seems to have preserved is a little rotation of the radius in a new

cavity which it had formed on the outer condyle. But when treated early reduction is generally very easy. Many dislocations of the elbow slip in on the least traction being made on the hand, probably, as hinted above, because the coronoid process is not fairly lodged in the olecranon fossa. If the coronoid process be fractured no obstacle to reduction can possibly exist. And even in the complete dislocation steady traction on the hand, combined, if necessary, with slight rotatory movements, will almost certainly disengage the coronoid process, which can then easily be slipped round the trochlea by bending the arm. An anæsthetic is generally unnecessary, but may be administered if the patient is usually timid, or if attempts without it have failed. If the surgeon have no assistance he generally places his knee on the projecting humerus, to make counter-extension, steadies the arm with his left hand, grasps the forearm with his right, and pulls it downwards, and then, when he feels the displaced bones move, he bends the forearm sharply, and they slip into place. Mr. Kelly of Dublin¹ suggests a method



FIG. 100. Dr. Kelly's method of reducing dislocation of the elbow.



FIG. 101. Dislocation of the head of the radius backwards. The head of the radius is much altered in form. The orbicular ligament had been carried away along with the head of the radius, and had taken an attachment to the humerus on either side of the dislocated head, so that the motions of pronation and supination were abolished. The outer condyle of the humerus is much changed in shape from deposit of new bone. The ulna is perfectly natural. Flexion and extension could be performed, through about a quarter of their natural extent. The preparation in St. George's Hospital Museum (Ser. i. No. 109) was taken from the body of a young man who had received a blow on the elbow about two years previously, and noticed the change in the shape and motion of the joint next day.

which I should think would prove very efficient and convenient in private practice. The surgeon sits on the edge of a table, the patient on a chair beside the table. The injured elbow is steadied against the surgeon's farther thigh, while his nearer thigh presses upon and steadies the humerus. Both hands are thus left free to make traction on and manipulate the forearm.

In old dislocations either the pulleys must be put on in order to bring the bones of the forearm downwards, and when they are thought to be disengaged reduction is attempted by acute flexion; or, after all adhesions have been broken down by various movements, the case is treated as a recent dislocation. Care must be used in such cases not to fracture the bones.² Section of the

¹ 'Dublin Journ. Med. Scien.' July 1885.

² Dr. Ogston of Aberdeen has related a case in which reduction was impossible in consequence of the end of the humerus having been driven through the brachialis anticus muscle, and believes that this is an occasional cause of irreducibility in dislocations complicated with fracture, 'Brit. Med. Journ.' Sept. 2, 1876.

triceps tendon may be useful in such cases, as in those referred to on p. 278, footnote.

Dislocation
of the head
of the ra-
dius only.

The form of dislocation which is most frequent next to that of both bones backwards is that of the head of the radius only, the ulna remaining in its place. This occurs either on the back (fig. 101) or the front (fig. 102) of the external condyle. Careful examination can hardly fail to detect in the dislocation backwards the projection of the displaced head, and the change in the axis of the bone, which are so well shown in the figure; in the dislocation forward the loss of the head of the radius from the part where it should be felt; and in both the total loss of the power of voluntary pronation and supination, and the almost total loss of passive motion. If the injury be overlooked the patient will lose more or less com-

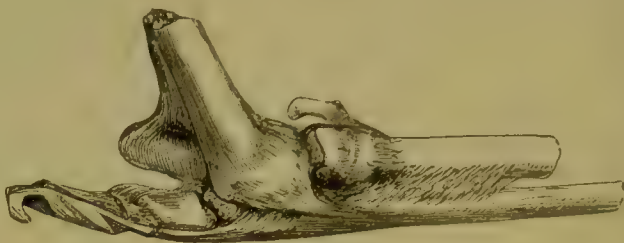


FIG. 102. Dislocation of the head of the radius forwards, at the age of two years, with fracture running through the cartilaginous olecranon. The dislocation was compound, and the child died of pyæmia.—From the Museum of St. George's Hospital, Ser. i. No. 110.

pletely the power of turning the hand, except by the comparatively awkward device of rotating the humerus. The dislocation of the head of the radius is remarkable as being one of the few which are not uncommon in early life, as fig. 102 shows. It has been known to be produced by traction made by the accoucheur on the child's hand in delivery. The forward dislocation is said by Fergusson and by Hulke to be the more common of the two.¹

In its reduction the forearm should be flexed so that the biceps may be relaxed, and then while an assistant manipulates the hand as directed, so as to approximate the head of the radius towards the ulna, the surgeon tries to press it directly into the lesser sigmoid cavity by the pressure of his thumbs supported by the counter-pressure of the fingers on the other side of the limb.

The rarer
disloca-
tions.

The other dislocations are much rarer. Both bones have been found dislocated laterally, the outward dislocation being the more common. A few instances have even been recorded of dislocation forwards, the olecranon process being thrown more or less completely down to the end of the trochlear surface of the humerus and the arm elongated; or the ulna alone may be dislocated from both the humerus and radius. It would serve no useful purpose to describe minutely the characters of these rare injuries, or to dwell further on the symptoms of the fractures of the various processes which are constant accompaniments of dislocation of the elbow. Great care is necessary in the examination of every case. After reduction the arm should be kept quiet on a splint for a fortnight at least, and should then be used very cautiously.

Compound
disloca-
tions.

When the dislocation is compound the surgeon is guided in his treatment chiefly by the amount of the concomitant lesions. If these are trifling it is better, especially in elderly persons, to reduce the bones, close the wound, and trust to early passive motion to restore some movement to the joint. If

¹ Mr. J. Hutchinson, jun., alludes to the subject of obscure sprains of the elbow occurring in young children, and believes that the injury consists in a slipping of the radius out of the grasp of the orbicular ligament, with rupture of the capsule connecting the ligament to the neck of the radius. The symptoms are pain and inability to supinate the hand, which is strongly pronated and the arm semi-flexed. The deformity disappears upon steadily supinating the forearm. See 'Annals of Surgery,' August 1885, p. 31.

the bones are considerably injured it may be better to perform excision of the whole joint; and if the great vessels or nerves be also injured, amputation may even be necessary, though this is quite exceptional.

The *lower radio-ulnar joint* may be dislocated; and as in this joint the radius is the movable bone, it is usual at the present day, following the analogy of the nomenclature of other dislocations, to call this a dislocation of the radius from the ulna, instead of the ulna from the radius, as Sir A. Cooper called it. The radius seems displaced forwards rather more commonly than backwards; the hand is of course displaced forwards, and the styloid process of the ulna projects backwards and sometimes comes through the skin. The opposite dislocation causes similar symptoms reversed. These injuries are caused by violent twisting of the hand. They are to be reduced by extending the hand and manipulating the radius into position. If there be a wound it must be carefully closed, and in any case the hand should be kept in splints for about a fortnight.

Dislocation
of lower
end of
radius.

Dislocation of the *wrist* occurs almost always backwards; the bones of the carpus project on the dorsal surface of the forearm, the articular surfaces and styloid processes of the radius and ulna being felt below them. The dorsal projection gives this injury some resemblance to Colles's fracture, especially when the hand is somewhat twisted, so that the styloid process of the ulna projects; and the two injuries were generally confounded together before Colles's time; but there is no real difficulty in the diagnosis, for the position of the styloid processes in relation to each other and to the hand is an unfailing test. In the dislocation the styloid processes bear their normal relation to each other, but lie much nearer to the fingers than natural. In the fracture the styloid process of the radius is displaced along with the hand, while that of the ulna, though prominent, is at nearly the same distance from the little finger as on the sound side.

Dislocation
of the
wrist.

Reduction is usually easy. It is better, I think, to keep the part quiet on a splint for a few days at first, and then to wear the hand in a sling for about a fortnight.

The dislocation in the other direction (i.e. with the hand in front of the forearm) very rarely occurs as a traumatic lesion. Its symptoms would be the same as the above reversed.

Though the bones of the carpus are so small, and so securely locked together, yet dislocations do occur. Such as I have seen have been compound. The Museum of St. George's Hospital contains a pair of semilunar bones which were exposed in a compound dislocation of both wrists, and were removed before the wounds were dressed. The patient died from other injuries, but the parts were unfortunately not preserved. Another preparation shows dislocation of the rest of the carpal bones from the semilunar, which alone remains attached to the bones of the forearm. The scaphoid was fractured, and the fractured portion extracted through the torn dorsal ligaments. I saw a short time since a case in which the greater part of the semilunar bone came away, but the patient recovered a very useful hand. In other cases the head of the os magnum has been the protruding part. I do not think any special directions need be given for the diagnosis and treatment of such injuries. The protruding parts are generally easily replaced, and the patient usually recovers the utility of the hand; the great point is to see that the motions of the fingers are early restored.

Disloca-
tions of the
carpus.

Dislocation
of the
thumb.

The first phalanx of the *thumb* is comparatively often found dislocated on to the metacarpal bone. The articulating surface of the phalanx usually lies on the dorsal surface of the metacarpal bone, though a few cases of the opposite dislocation have been met with. Either may be recognised at once by the shortening of the thumb, and by the projection on the dorsal aspect of the hand, formed, in the one case, by the displaced end of the first phalanx, in the other by the prominent head of the metacarpal bone. The dislocation backwards is often very hard to reduce.

When the first phalanx is carried backwards it takes with it the two heads of the flexor brevis pollicis, and the sesamoid bones developed in them; the anterior and lateral ligaments of the joint are torn off the head of the metacarpal bone, which tears a way for itself through the fibrous tissue uniting the two heads of the flexor brevis, between which it projects as a button does

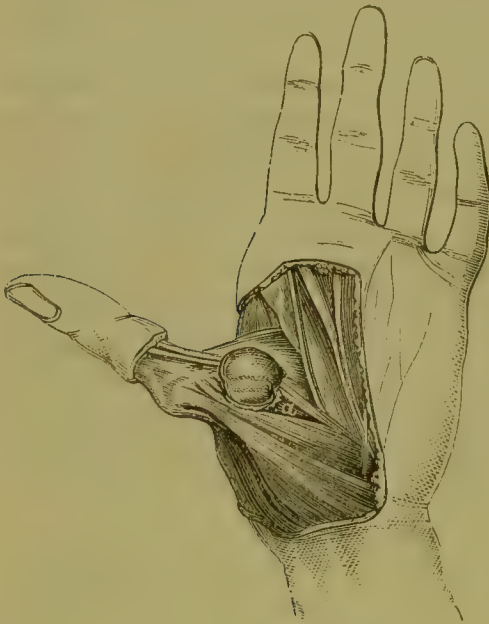


FIG. 103. Dislocation of the thumb backwards, showing how the displaced phalanx carries backwards with it the heads of the flexor brevis pollicis, and how the head of the metacarpal bone is consequently forced forward through a buttonhole opening in the tissue which unites those heads in front. The margin of this buttonhole is seen constricting the neck of the bone just above the letter *a* in the figure.—From the dissection of a dislocation artificially produced in the dead subject. After Fabbri.

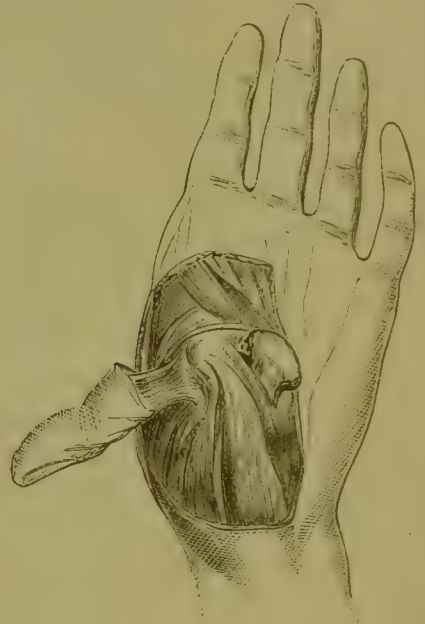


FIG. 104. Reduction of dislocation of the thumb (after Fabbri). The metacarpal bone is flexed as far as possible by squeezing it towards the centre of the hand. This carries the displaced phalanx with it, and so approximates the insertion and origin of the flexor brevis pollicis, relaxing the tissue forming the edge of the buttonhole, *a*. The dislocated thumb is then hyperextended, in order to slip the upper edge of this buttonhole round the prominent head of the metacarpal bone. When this is even partially effected the muscles will draw the phalanx into position.

The tension of the fibres of the flexor brevis pollicis in the former figure may be contrasted with their relaxation in this.

out of a buttonhole (see fig. 103). In these two conditions consists the difficulty of reducing the dislocation, viz. in the tension of the short flexor, and the difficulty of slipping the tissues forming the buttonhole over the mushroom-shaped head of the metacarpal bone. The first principle, therefore, in reducing any dislocation of the thumb which presents difficulty is to relax the short flexor, and this is done by forcibly adducting the thumb; i.e. pressing it as far as possible over to the middle line of the hand. This being done by an assistant, the surgeon takes the displaced first phalanx and places it in extreme extension, in order to relax the tissues of the buttonhole, and to push up those which form its distal part over the projecting head of the metacarpal bone. This is done by dragging the hyperextended thumb

downwards, i.e. away from the wrist, and then acute flexion will restore it to its place.¹

Such, I have no doubt, are the main obstacles to the reduction of this dislocation, and the appropriate method of obviating them. But there are probably in some cases other causes concurring, such as the interposition of some of the torn fibres of the ligaments, or of the fascia forming the distal portion of the 'buttonhole' between the ends of the bones,² and possibly the interlocking of the bony projections themselves. These minor obstacles can usually be overcome by slight rotatory movements of the phalanx during extension.

As there is often need for the application of considerable force, it is important to apply some apparatus which will keep firmly in place and at the same time not cut the skin. The Indian puzzle-toy, which holds the more firmly the more it is pulled upon, may be found useful; and there is a pair of forceps (called the 'American forceps'), manufactured for the purpose, with handles like those of the lithotomy-forceps, and two sheets of leather attached to the blades, which cross each other. The blades are fixed by a screw, so that they hold very firmly, while they can hardly damage the soft parts. But when such contrivances are not at hand a clove-hitch must be made of any appropriate material (the broader, softer, and stronger the better) and applied around the first phalanx, hitching against the projection of the joint. Or an ingenious clamp, which has been devised by Dr. Kelly,

and can be easily extemporised, may be employed (see fig. 105). Manual extension is generally sufficient; but I had once occasion to use the pulleys successfully. When reduction has been effected some surgeons recommend that the joint be flexed and extended once or twice to disengage any of the tissues which may have slipped between the bones.



FIG. 105. Dr. Kelly's clamp for reducing dislocations of the thumb.

It consists of two pieces of wood about six inches long, and half an inch broad, which are connected, not too tightly, at one end by a cord, close to which are transverse concavities to receive the first phalanx. It is made more secure and less painful by a strip of lint being wound round the grasping portion.

If all attempts at reduction by mere manipulation have failed, the case should be left for a time, cold being applied to combat inflammation; and if renewed careful attempts have no better result, the course generally followed is to make a subcutaneous section of the parts between the skin and the displaced phalanx on one or even both sides. This is usually spoken of as 'division of the lateral ligaments'; but it really, I presume, involves a more or less complete division of the head of the flexor brevis, and is successful when the 'buttonhole' is laid open, and the metacarpal bone

thus liberated. Another plan, recommended by Dr. Humphry,³ is to introduce a blunt hook, through a small incision, beneath one of the sesamoid bones, and draw it forwards with the phalanx. I have seen both plans successfully adopted; but I believe neither will often be required if Prof. Fabbri's directions are carefully followed in the manipulation. In a case under Mr. Rouse's care, all attempts at reduction having failed, an incision was made over the head of the bone, the displaced sesamoid bone was drawn

¹ The difficulties attending the reduction of this dislocation, and the method of obviating them, are admirably described in a memoir by Prof. Fabbri, in vol. x. of the 'Memorie dell' Accad. delle Scienze dell' Istituto di Bologna.'

Mr. Kelly ('Dublin Journ. of Med. Sci.' May 1883) attributes the difficulty in most cases to the interposition between the bones of the anterior ligaments, or the fascia uniting the sesamoid bones in front.

³ Humphry on the 'Skeleton,' p. 434.

aside with a hook, and then the dislocation was easily reduced. The patient recovered the complete use of the part. This plan differs from Dr. Humphry's proposal only in the free exposure of the displaced parts; but this seems to me its great advantage, and after witnessing its complete success in this instance I should be disposed in a future case to adopt it in preference to subcutaneous sections. Finally, if all fails, the case must be abandoned, passive motion being early and sedulously practised. Cases are on record in which the thumb, though dislocated, has been very freely movable.

When the dislocation is compound, the projecting bone, which may be either the phalanx or the metacarpal bone, should be removed, and passive motion early practised.

Dislocation
forwards.

Of the dislocation of the phalanx forwards, four examples are related by Nélaton.¹ One of these, though seen early and treated by some of the best surgeons in Paris, remained irreducible.

Dislocation
of the
fingers.

The phalanges of the fingers are rarely dislocated, but occasionally, in a fall, this injury may take place at any of the joints, the distal bone being generally thrown behind the proximal. The injury is tolerably often compound. Reduction is usually quite easy. I saw one case of old dislocation in which I found it impossible; but the patient was not in a condition to explain the circumstances to me, and I believed that it had been neglected. After the reduction the finger should be bound up for a few days, to prevent any use of it until the torn ligaments have consolidated, and then careful passive motion should be given.

¹ 'Path. Chir.' vol. ii. p. 23.

CHAPTER XV.

INJURIES OF THE LOWER EXTREMITY.

SPRAINS of the joints of the lower extremity are amongst the commonest Sprains. injuries in surgery, especially of the ankle and knee, and in the ankle it is often difficult to decide whether there is fracture or no. The injury is often a severe one, causing great pain at the time, being accompanied probably with much laceration of the ligaments and other structures near the joint,¹ and leading frequently to prolonged lameness. Severe sprains are followed generally by a good deal of effusion into the synovial cavity, which is sometimes slow to disappear; and they often lay the foundation of permanent disease of the articulation. Hence we can hardly be too careful in our treatment of them. At first, while the active state of effusion is present, antiphlogistic measures are necessary. When it is grateful to the patient the sedulous application of cold by means of icebags is, I think, the best; but if this is not tolerated, leeches, followed by warm fomentations, or evaporating lotions, or irrigation with spirit-and-water, will best check the tendency to effusion. As soon as the patient can bear it, equable pressure, by strapping and bandage or by splints, with perfect rest, should be adopted, and is one of the most potent means of cure in such injuries. But it is important, as soon as the patient has lost all pain, or if he has not quite lost pain, yet as soon as he can bear passive motion without renewed swelling and inflammation, to commence bringing the joint into use, by cautious motion and shampooing at first, and then by more free motion of it day by day, combined with steaming and free rubbing in of oil, and to encourage the patient to exercise it as much as he can without harm. Sir J. Paget has called attention to the coldness which affects joints which have been kept too long at rest, and he cautions his readers in the following emphatic terms against the bad effects of too-protracted inaction: 'Too long rest is, I believe, by far the most frequent cause of delayed recovery after injuries of the joints in nearly all persons who are not of scrofulous constitution. In the healthy, the chronic rheumatic, and the gouty, it is alike mischievous; and not only to injured joints, but to those that are kept at rest because parts near them have been injured. Mere long rest stiffens them and makes them over-sensitive; cold douches and elastic restraints and pressures make them worse, and nothing remedies them but movement, whether forced or voluntary.'² And he points out that such cases are the most frequent examples of the class which are cured by the rough manipulation of the bone-setter, who gets a joint which has been sprained and kept too long at rest, then pretending or believing that it has been dislocated wrenches it, and tells the patient that it has been put in, and that now he may use it. The patient, finding himself able to do so, naturally believes what the quack tells him, and thinks that his surgeon has overlooked

¹ The tendons in some of these cases may be displaced from their grooves, or so loosened as to be dislocated in a subsequent accident. See Chapter XXV. Mr. Morris's article on Injuries of the Lower Extremity, 'Syst. of Surg.' 3rd ed. vol. i. p. 991, contains an interesting and complete account of the anatomical lesions usually met with in sprains.

² 'Clinical Lectures,' p. 96.

a dislocation. The real fact is, that rest of the sprained joint has been carried on too long. But this fact—though there can be no doubt of it, and every one must have had frequent opportunities of verifying it—must not lead us into the opposite error of decrying the use of complete rest in sprains, especially in the lower limb; nor into that of insisting on too early passive or active motion, which would reproduce the inflammation and much prolong the mischief. Passive motion, shampooing, &c., should be begun as early as seems prudent, but always gradually and with caution, and at first with prolonged intervals of rest.

Contusion
of joints.
Hæmar-
throsis.

Sometimes after severe sprain or contusion a joint (more particularly the knee) will become rapidly filled with blood—a condition to which Mr. Fagan¹ gives the name of hæmarthrosis. The swelling is to be distinguished from that of traumatic synovitis by its immediately following the injury, by its being unaccompanied by heat and pain, by the absence of resistance or pain on passive motion, by the absence of fever, and by the persistence of the swelling in spite of the treatment which would relieve synovitis. Mr. Fagan strongly urges the removal of the fluid-blood by aspiration (repeated if necessary), which he has found safe and effectual in fifteen cases in his own practice.

Wounds.

Of knee-
joint.

Wounds of the lower extremity need not detain us in this place. The injuries of large arteries (as the femoral) have been spoken of above. The wounds of joints, and especially of the knee-joint, are the most striking feature in the regional surgery of such injuries. When the knee-joint is opened by a clean cut the nature of the injury is known by the escape of synovial fluid and by the effusion into the cavity. Unless a foreign body is known to be lodged, no probing or other examination is admissible. Otherwise the cut is to be carefully united, dressed with antiseptic dressing, and kept completely quiet and at rest on a splint. If the wound is lacerated and contused, or there is reason to believe that it has been exposed to contamination, the joint must be thoroughly washed out with carbolic acid lotion (1 in 20) and every particle of blood clot and foreign matter carefully syringed away, and a drainage-tube inserted in the most dependent part. The external wound must now be closed with sutures, the wound dressed with some antiseptic dressing, and fixed on a splint. If the case does well the patient recovers usually with more or less of ankylosis, though possibly in some cases complete movement may be preserved. In many cases, however, septic inflammation ensues, and the case resolves itself into one of acute abscess of the joint, for which see the chapter on Diseases of Joints.

Foreign bodies may lodge in wounds, especially of the buttock, and are frequent in the foot; but I can add nothing on this head to what has been said above (p. 246).

Fracture
of cervix
femoris.

Fracture of the neck of the femur—a common accident in old persons of both sexes—takes place entirely within the capsular ligament of the hip-joint, or else partly or wholly external to that cavity. The former fractures are called *intracapsular*, the latter *extracapsular*.

The annexed figures will show the usual forms of fracture of the neck of the femur. The division into extra- and intracapsular—which was made by Sir A. Cooper, and which is ordinarily followed in our schools—appears to me one of considerable importance; but another of equal and, according to the judgment of some writers of great authority, of even greater practical

¹ 'Brit. Med. Journ.' Sept. 22, 1883.

value, is into the impacted and the non-impacted fractures. The series is not, of course, intended to exhibit all the varieties which are met with, but it does show those which are most clearly distinguishable from each other, and the characters of which it is important to bear in mind.



FIG. 106. The common, non-impacted, intracapsular fracture of the neck of the thigh-bone.—From a preparation in St. George's Hospital Museum, Ser. i. No. 180.



FIG. 107. The common, impacted, extracapsular fracture of the cervix femoris. From a woman aged seventy-four at the time of her death, who had had fracture on one side four years, on the other five weeks, before her death, both injuries being almost exactly similar. The old injury was completely united by bone; the recent one, here shown, was firmly impacted, but the fragments separated in maceration.—St. George's Hospital Museum, Ser. i. No. 207.

Fig. 106 is the truly intracapsular fracture which generally occurs in old age, and often from slight causes; it is usually free from impaction, and rarely found united by bone.



FIG. 108. The common, comminuted non-impacted fracture of the neck and trochanters.—From a specimen (Ser. i. No. 142 b) in the Museum of St. George's Hospital.



FIG. 109. A gunshot wound, causing intracapsular fracture of the neck of the femur, in a young man (aged 25). A charge of small-shot passed through the hip-joint, from a very short distance, at the back of the limb ('balled,' according to the common expression), cleanly dividing the femur. It will be noticed that the back part of the bone is notched by the shot in two or three places. From a specimen in St. George's Hospital Museum, Ser. i. No. 136.

This fracture, however, may be impacted, and in such cases, at any rate, bony union does occur. This is shown by Fig. 112.

Fig. 107 shows the ordinary impacted extracapsular fracture which occurs both in old age and at earlier periods, in which the upper fragment (comprising the head and the whole of the neck) is driven into the cancellous tissue of the base of the trochanter, and firmly wedged there; so that in the case from which the preparation was taken, and where the same fracture had occurred on both sides, at four years' interval, in the recent fracture the upper fragment was so firmly wedged into the lower that it was only separated by maceration. This fracture unites always by bone.

Fig. 108, on the other hand, represents the common form of comminuted fracture of the neck and trochanters, also produced at any age by considerable violence, and in which impaction is usually prevented by the free splitting of the lower fragment, though in other cases the fragments may be variously impacted or interlocked. Union will occur if the patient has sufficient vital power, and if not interfered with by inflammation, abscess, and necrosis of detached fragments.

Fig. 109 is introduced to illustrate the occasional occurrence of lesions of the neck of the femur at earlier ages, in this case from direct wound; and will also be hereafter referred to in connexion with the treatment of such injuries when compound.

Symptoms
and diag-
nosis of
fracture of
cervix
femoris.

The neck of the femur may be known to be fractured by the following signs. After an injury, of more or less severity, the patient is unable to walk, or even in most cases to move the limb, complains of great pain on passive motion, the affected limb is shorter than the other, the foot, as well as the whole limb, is everted in most cases. If no impaction exists, the length of the limb may be restored by traction, and crepitus will then easily be obtained. On rotating the limb the trochanter is observed to move through a smaller arc. If the fracture is impacted the trochanter moves along with the head of the bone, and in a circle of which the head is the centre. The position of the trochanter major is a matter of much importance in fractures of the neck of the thigh-bone. In the ordinary non-impacted fracture, shown in Sir A. Cooper's figure, the trochanter is sunk as well as displaced upwards. In the rarer cases of impacted fracture with inversion it is of course prominent, but in all cases it is nearer to the pelvis than natural. This displacement can be verified either by 'Nélaton's test' of stretching a string from the anterior superior spine to the tuber ischii—which in the natural condition only just touches the top of the trochanter, or lies wholly above it—or by Mr. Bryant's method of measuring the vertical distance between the top of either trochanter and a horizontal line which touches both the anterior superior spines,¹ or by



FIG. 110. Fracture of the neck of the thigh-bone. After Sir A. Cooper. The figure shows the advanced age of the patient, the shortening and eversion of the limb, and the falling in of the trochanter.

¹ Bryant, 'On the diagnostic value of the ilio-femoral triangle,' 'Proc. of Med.-Chir. Soc.' vol. vii.

Mr. Morris's of measuring the distance of a perpendicular drawn through the outside of the great trochanter on the two sides from the centre of a rod or string stretched across the body just above the pubes (bi-trochanteric measurement). On the injured side the distance is always less.¹

The diagnosis between a case of fracture and one of mere *contusion* of the hip is usually easy, all the above characteristic symptoms, except the loss of motion, being absent in the less serious injury.² There are cases, indeed, in which the shortening is very slight, and where the eversion consists less in obvious turning out of the foot than in a fixed condition of the limb; where, though the foot does not visibly point outwards, yet it cannot be made to turn inwards, as the other can. Here there is probably fracture high up, with impaction, and the patient may recover very perfectly. An interesting case will be found on p. 133 of Bigelow's work. In some instances it appears that interstitial absorption of the cervix femoris follows after mere contusion,³ as it undoubtedly does after fracture; and in such cases it would be impossible, some months after the receipt of the injury, to know that no fracture had taken place. From dislocation there is usually no difficulty in the diagnosis. The everted position of the foot and the free mobility of the limb distinguish the ordinary cases from any form of dislocation (compare Fig. 110, with Figs. 138, 140, 144, and 148); while in an impacted fracture with inversion of the foot,⁴ simulating at the first glance dislocation on to the dorsum ilii or into the sciatic notch, the absence of the head of the bone from the buttock will distinguish it from the former, and the much greater freedom of passive motion in all directions (especially if the patient be under the influence of chloroform) from the latter dislocation.

There is a very rare form of fracture of the pelvis in which the head of the femur is driven into and more or less completely through the acetabulum.⁵ I

¹ 'Syst. of Surg.' 3rd ed. vol. i. p. 1003.

² It is said, however, that cases of fracture occur in which the fragments remain at first in their natural contact with each other until displaced by the movements of the patient or some accidental cause. If this is true, such a case might (though only for a short time) be mistaken for a mere contusion.

³ I have myself seen this shortening from interstitial absorption come on gradually in a case which was carefully examined soon after the injury by myself and other surgeons, who were all satisfied that no fracture existed. See also Wilks and Moxon, 'Path. Anat.' 2nd ed. p. 36.

⁴ Inversion in impacted fracture depends on the usual kind of impaction being reversed. Instead of the neck being driven into the tissue at the base of the trochanter major driving the trochanter backwards, the two trochanters are widely separated from each other, and the neck, wedged in between them, has so pushed forward the trochanter and lower fragment as to turn the whole femur inwards on its own axis. In Bigelow's work and in some papers published by him in the 'Boston Medical and Surgical Journal,' January 1875, the reader will find some interesting speculations on the structure of the neck of the femur and the effect of such structure on the impaction of fracture. The eversion which accompanies the common non-impacted fracture appears to me to be due chiefly to the natural tendency of the foot to fall outwards when the muscular force is removed from the limb. This is constantly observed in sleep and in coma, and after non-impacted fracture of the femur in any part, the limb is in a somewhat similar condition in respect to muscular action. I am not inclined, however, absolutely to deny that the external rotator muscles may be enabled to act at greater advantage on the lower fragment after the fracture of the neck and the shortening which follows it, as Mr. Davies-Colley argues. See this question ably discussed by Mr. Owen, Mr. Spence, and Mr. Davies-Colley in the 'Brit. Med. Journ.' Oct. 4, Nov. 1, and Nov. 15, 1879.

⁵ See 'Med.-Chir. Trans.' vol. xxxiv. p. 107. There is a specimen in the Museum of St. George's Hospital, Ser. i. No. 123, showing this injury, which was mistaken for fracture of the neck of the thighbone, as mentioned in the text. See footnote 4, p. 238.

have seen this injury mistaken for fracture of the cervix femoris, and the mistake is really of very little consequence. But if any doubt existed it might probably be set at rest by examination under chloroform, since the head of the bone is believed to be usually jammed tightly into the pelvis in these cases. But the injury is a very rare one, and little is therefore known as to its symptoms.

Diagnosis
of intra-
from extra-
capsular
fracture.

The above account shows that there is not generally any great difficulty in deciding whether the neck of the femur is or is not fractured. It is usually less easy to be sure whether the line of fracture is or is not wholly intra- or wholly extra-capsular; and indeed the great majority of fractures cannot strictly be limited by either term, for the line of fracture, though partly or chiefly below the attachment of the capsule, will be found to pass up into the cavity of the joint. In well-marked instances of either class the following rules will apply: 1. Intracapsular fracture is more purely an injury of old age than the extracapsular form. The absorption of the bone from senile atrophy, producing fatty degeneration of its tissues, shortening, and loss of the natural obliquity of the neck of the femur, must render it prone to give way from very slight causes; and thus, in extreme old age, the neck of the thigh-bone is sometimes broken from the most trifling injuries, even from catching the toe in the carpet or bedclothes. Such fractures are in all probability intracapsular.¹ It is, however, a mistake (though one often committed) to believe that this change in the neck of the thigh-bone is one which is universal or nearly so in old age, and that therefore most fractures of the cervix in old people are intracapsular. On the contrary, the change in question only occurs in some proportion (hitherto, I believe, undetermined) of the aged; and the extracapsular is certainly more common in old age than the intracapsular fracture. This latter form, however, is almost exclusively found in the aged. When, therefore, the fracture has occurred from a very slight cause in an old person, we conclude that it is probably intracapsular.



FIG. 111. Section of the femur to show the atrophy of its head and neck, and the alteration in the direction of the latter from senile changes. The head is on a lower level than the great trochanter, and the neck has a horizontal instead of an oblique direction.—St. George's Hospital Museum, Ser. ii. No. 7.

2. If the fracture be not impacted the amount of shortening which immediately follows the injury is usually less after the intra- than the extra-

¹ Fractures of the neck of the femur caused by such trifling injuries can hardly be impacted, but that more powerful sprains may lead to extracapsular fracture which may even be impacted, has been shown by an interesting case published by Dr. Reidinger of Würzburg in the 'Centralblatt f. Chir. 1875,' p. 52. A man of sixty, slipping on the snow, tries to save himself and falls on his *left* side. He rises and makes a few steps with very grievous pain, and then perceives that his *right* leg is shortened. Examination proves the existence of an extracapsular fracture with slight impaction. The fracture must have occurred in consequence of the neck of the femur being caught between the twisting force of the fall and the resistance of the ilio-femoral ligament. The impaction was probably caused by the attempt to walk.

capsular fracture, and there is less crepitus, if the surgeon thinks it desirable to make the manipulation necessary in order to elicit the crepitus. But this, in my opinion, should rarely if ever be done. It puts the patient often to much pain, and may have an injurious effect on the progress of the case, which the object sought to be obtained does not justify.

3. The surest test between an intra- and extra-capsular fracture when it is available (which, however, in the majority of cases it is not), is to note whether the trochanter moves with the lower fragment. If the movement of the lower fragment is not communicated to the trochanter the fracture cannot, of course, be above the intertrochanteric line; but the movement of the trochanter along with the lower fragment does not prove the contrary (i.e. that the fracture is intracapsular), since the fragments may be more or less closely interlocked.

Such are the characters which seem to me worthy of study when we wish to distinguish these two forms of fracture from each other. I may add that they become less trustworthy the more completely the fragments are impacted. This impaction happens much more frequently in the extracapsular form, so frequently, indeed, that one great authority—Dr. R. W. Smith—believes that all extracapsular fractures are impacted at the moment of injury, though doubtless the fragments are often detached from each other afterwards.

When the impaction is complete the fragments cannot be moved on each other by any force which the surgeon would employ. Hence the shortening cannot be made to disappear, nor can crepitus be elicited. But in less firm impaction (or perhaps simple interlocking of the fragments) passive motion detaches them, crepitus is produced, and when extension is removed the shortening is found to have become much greater than before.

The *treatment* of fracture of the neck of the thighbone will depend Treatment.
mainly on the age and constitutional condition of the patient. Sir Astley



FIG. 112. Bony union of intracapsular fracture.
—From St. George's Hospital Museum, Ser. i.
No. 142 a.

Cooper proved that fracture of the neck of the thigh-bone within the capsule does not usually unite by bone. In some rare cases it will do so, as shown in the annexed figure; and it is probable that when it does do so the cause is generally impaction of the fractured head in the tissue of the cervix, as was the case in that instance.¹ More commonly the union is ligamentous or there is no union at all, and in the latter case the fractured surfaces are often polished off, and a kind of false joint is found in the interior of the true one. The causes of this defect of union are variously stated. There can be no doubt that the main reason is the impossibility of keeping the ends in contact, and perhaps the frequent

slight misplacements to which, under the action of the muscles inserted into the trochanter, the lower fragment is constantly liable. But many other

¹ Two similar instances of bony union of intracapsular fracture with impaction are recorded and figured by Bigelow, 'On Dislocation and Fracture of the Hip,' pp. 131-135. The figures are strikingly like that in the text.

causes have been assigned, viz. the age of the patient, the atrophy of the bone, the percolation of synovial fluid between the fragments, and the small supply of blood to the upper fragment—only from the small branch which runs in the ligamentum teres. The first is a cause about which there can be no doubt; and in the only other very common injury where non-union is the rule, viz. the transverse fracture of the patella, the conditions are similar in respect to the impossibility of proper coaptation of the fragments, though in every other particular they are usually quite different. This, therefore, may safely be regarded as the main reason, though some others may conspire in preventing bony union. This want of bony union exists, however, only in the intracapsular fracture. Extracapsular fractures unite as soundly as any other fracture.

The treatment which Sir Astley Cooper recommended consisted merely in supporting the knee on a pillow, keeping the patient in bed until movement was no longer very painful to him—say from a fortnight to three weeks—and then allowing him to get up and move about as much as he could with ease. The result of this would, of course, be the non-union of the fracture;

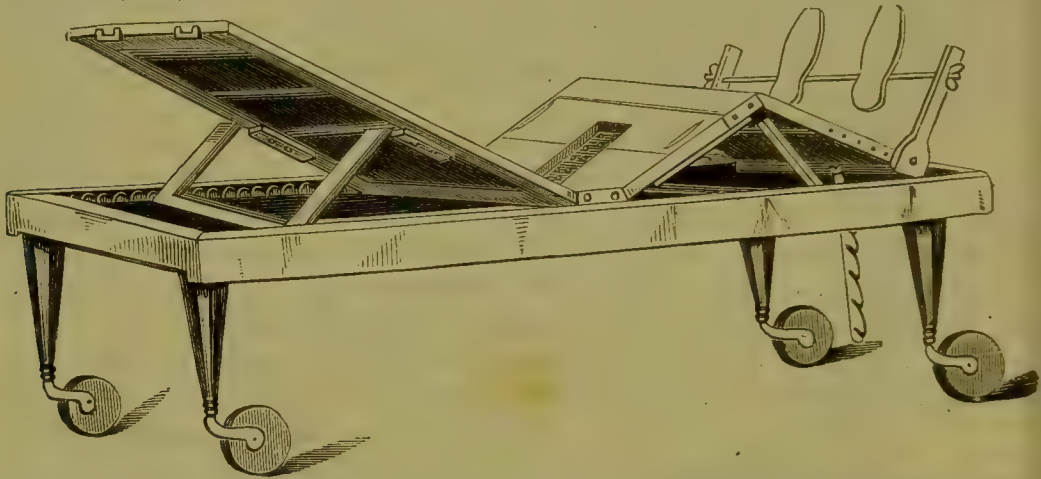


FIG. 113. Earle's bed, or the double inclined-plane for the treatment of fracture of the upper part of the femur. Extension is made by fixing the foot, or feet, to the movable foot-pieces at the bottom of the bed. Counter-extension is made by the weight of the body gravitating down to the bottom of the bed, in which there is an opening for the passage of the dejecta.

but this was a matter of minor importance in Sir A. Cooper's view, since he laid so much stress on the fact that intracapsular fractures do not as a rule unite by bone. And there can be no doubt that if attempts are too much persisted in to procure consolidation of the fracture by rigid confinement during many weeks, the patient (being an old person) is almost sure to suffer from sloughing produced by the splints, or from bedsores, and will very likely die. In such patients therefore the treatment above described, or something like it, is the best. But this does not apply to fractures of the neck of the thigh-bone in younger and more vigorous people. In them the fracture is either impacted or non-impacted. If the former, no attempt should be made to disengage the fragments, since it cannot be done without an amount of violence which would be highly dangerous, and which is quite unjustifiable. Such impacted fractures require only rest for their consolidation. The limb is steadied by the application of a weight to the foot, along with a case of splints lightly applied to the thigh, or by the long splint, for about six weeks, when it can be put up in a starched pasteboard, or a Hides's felt splint. Comminuted and other non-impacted fractures in patients tolerably vigorous and not too old are to be treated with the long splint, just like any other

fracture of the thigh. Some surgeons prefer Earle's bed in these cases, and it is certainly less exposed to the risk of producing ulceration or sloughing of the skin, although it makes far less efficient extension than the long splint.

Some alleged cases of disjunction of the upper epiphysis of the femur are recorded;¹ but they do not seem to me conclusive as to the real existence of this lesion as a substantive injury.

Other fractures of the upper end of the bone.

Fracture of the trochanter major, without any solution of continuity of the shaft or neck, has been known to occur both before and after the junction of its epiphysis. One in an old man is recorded and figured by Sir A. Cooper,² and in a girl of sixteen by the same author, on the authority of Mr. Aston Key. It was caused by direct violence. The symptoms given are pain at the part, and particularly on passive motion, eversion of the foot, deformity of the trochanter, and crepitus, without shortening of the limb. The injury is to be treated in the same way as fracture of the cervix. The fracture unites well,

and the limb will very probably be perfectly useful.



FIG. 114. Fracture of the upper third of the femur with great displacement. From Sir A. Cooper's work on 'Fractures and Dislocations' (pl. xii. fig. 6), thus described by him: 'The thigh-bone fractured below the trochanter minor, and drawn into a most deformed union by the action of the psoas and iliacus internus muscles.'

Fracture of the shaft of the femur is a very common accident, and it generally occurs in the middle of the bone, at a variable level. The cause is usually indirect violence, i.e. a fall or strain, by which the bone is bent and snaps; in rarer cases it breaks in consequence of a direct blow upon the thigh. There is rarely any difficulty in recognising the nature of the

injury, as the lower part of the limb is freely movable. Exceptional cases, in which impaction causes some amount of difficulty, will be recognised by the alteration in the length and in the axis of the limb.

Three forms of fracture of the shaft of the femur are described, viz. fracture of the upper third, of the middle, and of the lower end.

Fracture of the upper third of the femur is a formidable injury. In the words of Sir A. Cooper,³ 'it is a difficult accident to manage, and miserable distortion is the consequence if it be ill-treated.' The distortion to which Sir Astley refers is that shown in Fig. 114, copied from his work, showing the upper fragment tilted forwards and outwards, and the lower fragment lying under it, irregularly united to it by a bridge of bone, the axes of the two fragments forming a great angle. But this distortion is not the one which is

Fracture of the upper third of the femur.

¹ 'Syst. of Surg.' 3rd ed. vol. i. p. 1008.

² 'On Fractures and Dislocations,' 2nd ed. pp. 158, 171. The dissection of an old specimen of this injury is well described by Dr. Warren. 'Dublin Journ. Med. Sci.' July 1876.

³ See the section 'On Fractures below the Trochanter,' in Sir A. Cooper's work, 'On Dislocations and on Fractures of the Joints.'

always found in these cases. Fig. 115, from the Museum of St. George's Hospital, shows an equally 'miserable distortion,' but in the opposite direction, since here the upper fragment remains in its natural position, while the lower fragment is driven across the front instead of the back part of the upper, and points upwards and outwards. In both cases the foot must have been far from the ground, and the patient could only have walked with great slowness and difficulty. Sir A. Cooper refers the distortion to the action of the psoas and iliacus, and to that only; but the explanation is evidently imperfect. Allowing that these muscles may exercise traction on the upper fragment, it is evident that they cannot abduct it as well as flex it (as is seen in Fig. 116), and this part of the displacement in this and cases similar to this is now ascribed by most surgeons to the pressure of the lower fragment, which often



FIG. 115. Oblique fracture of the femur, just below the trochanter minor, most irregularly consolidated. The upper fragment appears to have retained its normal position, but the lower one crosses the front of the upper fragment obliquely from within outwards, and is firmly united to it by a bridge of new bone passing from the fractured end of the upper fragment to the surface of the lower fragment below the fracture. The medullary canal of the upper fragment was filled up by bone at the seat of injury, but in the lower fragment it is pervious. The head of the femur presents several irregular projections of bone, one of which, close to the attachment of the ligamentum teres, is of a curious hook-like form, and fitted into a similar depression in the acetabulum. The cartilages of the hip joint were almost destroyed, but there was no pus in the joint nor any adhesions. The preparation was found in examining the body of a man aged seventy-six, who died of disease of the kidneys and bladder.



FIG. 116. Fracture of the femur immediately below the trochanters, seen on the anterior aspect. The lower fragment has passed immediately behind the upper, and the latter is driven into a position of extreme abduction, so that the head is inclined considerably inwards and forwards. An enormous callus enveloped the two fragments behind, and in this anterior view a broad and long osseous stalactite is seen leaning against the lower part of the head of the femur, as if giving it support. It is remarkable that the upper fragment, though in front of the lower, is not flexed in the slightest degree. On the contrary, one might say that it had been directed a little backwards, as if to meet the lower fragment. The shortening, due to the riding of the fracture, seems to have measured about an inch.—From Malgaigne's 'Atlas,' pl. xiii. fig. 1.

drives the bone upwards, though others believe that the action of the abductor muscles is also called into play. The shortening is often caused really more by the abduction and the consequent angular deformity than by the riding or anterior displacement (Fig. 117). Evidently the position of the lower fragment is the point to which the greatest attention should be directed, both in the reduction and in the after-treatment. The great point, as it seems to me, is to disengage this fragment, in whatever position it may be lying, to draw it down and to place it in the axis of the limb, for which purpose it is desirable to put the patient under chloroform; and it may be justifiable in extreme cases even to apply the pulleys. When the fracture has thus been completely reduced I have never seen any evil consequence, nor any difficulty in treating it by means of the long splint, which is far more trustworthy than any other

apparatus in this fracture. I have never seen cases successfully treated by the double-inclined plane (Earle's bed), recommended by Sir A. Cooper; in fact, it appears to me to exercise no influence whatever on the progress of the case, and to be very insufficient as a safeguard against the reproduction of the displacement, which is the real danger. If, however, the surgeon is so under the influence of a venerable authority as to fear the action of the *psoas* in displacing the upper fragment, he can adopt Mr. Busk's thigh-splint, in which there is a joint at the hip, so that the body can be flexed while the long splint steadies the lower fragment.

In fractures of the middle of the bone the lower fragment generally lies behind and above the upper, either to its inner or outer side. Fig. 118 and Fig. 30 (p. 129) illustrate varieties in the displacement of this fracture, but

Fracture in the middle of the bone.



FIG. 117. Fracture about two inches below the small trochanter. The upper fragment is directed considerably outwards; its anterior projection does not measure more than one-third of an inch, and this is all the shortening that is due to the riding of one fragment on the other, while the shortening due to the angular deformity is more than an inch. From Malgaigne, pl. xiii. fig. 2.



FIG. 118. An old, badly-set, fracture of the femur, united by a large bridge of bone, which covers over the medullary canal of both fragments. The upper fragment projects on the outer side of the lower, and is directed from above outwards and forwards, while the lower is displaced considerably upwards, and points from below also, backwards and outwards. Compare this with Fig. 30, p. 129.

it is certainly almost constant for the upper fragment to be in front of the lower; the foot also is always everted or rotated outwards, unless in some rare cases the fragments should be so interlocked that it is driven inwards. The main cause of both displacements seems to be the weight of the lower part of the limb. It is not impossible that the *psoas* and *iliacus* may raise the lower end of the upper fragment, and that the hamstring muscles may draw the lower backwards, and this explanation is accepted by many authors; but it seems to me that when the support of the skeleton is withdrawn by snapping the femur the leg naturally falls backwards and the foot outwards. At any rate, if muscular action has anything to do with the displacement, it does not usually affect the treatment to any recognisable extent. This

treatment consists first in the careful setting of the fracture, and in doing this the surgeon should not grudge the time necessary to verify its accuracy. He should ascertain by the most exact measurement that the length of the fractured thigh is the same as the other, and, by careful comparison of the various points of the two limbs, that there is no angular or rotatory displacement. The treatment which is usually adopted at St. George's, and I believe at all the other London hospitals, is that by the long splint—whether Desault's or Liston's makes little matter—assisted by short splints, encasing the thigh, and preventing any minor displacements of the fragments on each other (Figs. 119, 120). These latter, perhaps, are not abso-

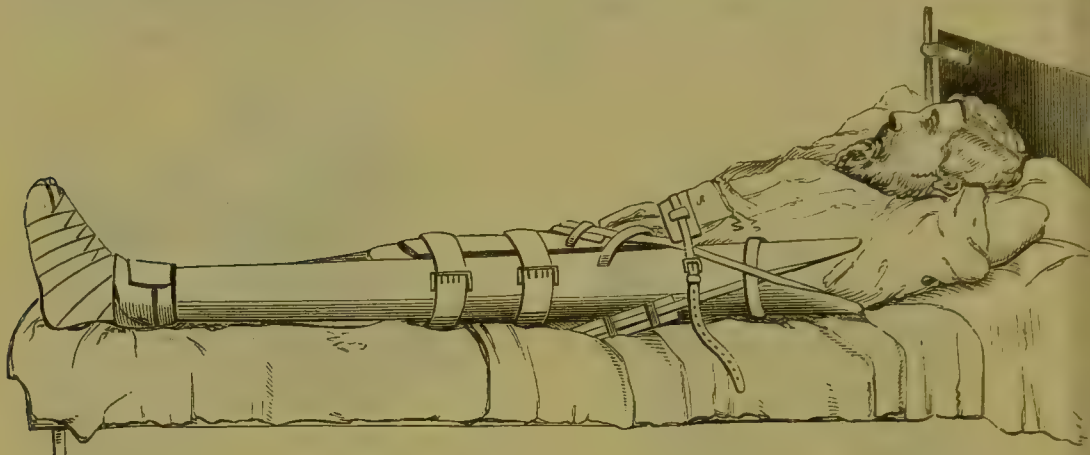


FIG. 119.

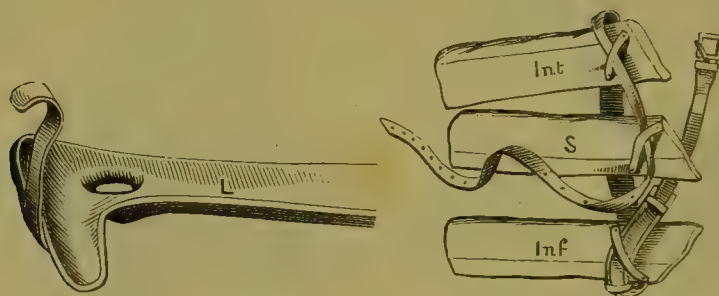


FIG. 120.

FIGS. 119 and 120. A fracture of the thigh put up with Desault's long splint and short thigh-splints. Fig. 119 shows the general features of the apparatus. The long splint extends from the foot to the axilla. Desault's splint is provided with a foot-piece, as shown in Fig. 120. Liston's splint, which is in more constant use, though I think inferior to Desault's, ends in a notched extremity, extending several inches below the foot, the object is to correct the tendency to eversion of the foot by the traction exercised on it by the bandage passing through the notch. The objection to it is that, in the words of a late house-surgeon at one of the hospitals where it is in use, 'it is apt to strain the ankle-joint, and sores are likely to form about the malleoli, and over the tendo Achillis' ('Lancet,' Oct. 10, 1874, p. 512). The short splints are strung on the perineal band, as shown in Fig. 120. They are secured by a couple of webbing straps, and the long splint is kept in position by a bellyband. The perineal band is passed through the notch, then around the splint from below upwards, and finally out of the notch again, being buckled outside the splints. This buckle has been accidentally omitted in Fig. 119.

lutely necessary, and some surgeons only use the short splints to correct any deformity which is obvious. If short splints are not used, it is an old and, I believe, good practice to bandage the limb evenly and carefully up to the seat of fracture, and some surgeons carry the bandage up the whole limb.

There are many other methods of treatment, of which I cannot profess much personal experience; for though I have occasionally tried some of them, I have not found any reason for thinking that they are superior to the above in the ordinary fractures of adults, while they unquestionably involve some risk, and are not so easy of application. Thus, the American surgeons are fond of applying the constant extending force of a weight passing over a pulley at the bottom of the bed, counter-extension being applied by fixing a perineal

band to the head of the bed, so that the patient cannot get down below a certain level in it. The weight is in some cases supplemented by short splints applied between the knee and the groin. The amount of weight must be regulated by the size of the limb. For an adult probably ten or twelve pounds would be about the average (Fig. 121).

Other plans contemplate a combination of the steadiness of the long splint with the permanent extension produced by the weight, substituting for the latter a spring or indiarubber band or accumulator inserted into a jointed splint. Such is the splint invented by Mr. Cripps, in which the foot is drawn down and kept down by a constant elastic force, and of which Mr. Bryant speaks in high terms; and other similar apparatus have been invented by Mr. De Morgan and other surgeons, but I have not sufficient experience of them to have formed any opinion of their real practical value as compared with the usual plan of treatment.¹

Many surgeons adopt the plan of putting up the fractured thigh at once, or very soon after the accident, in an immovable apparatus, such as a starched bandage, a plaster-of-Paris splint, or a leather collar.

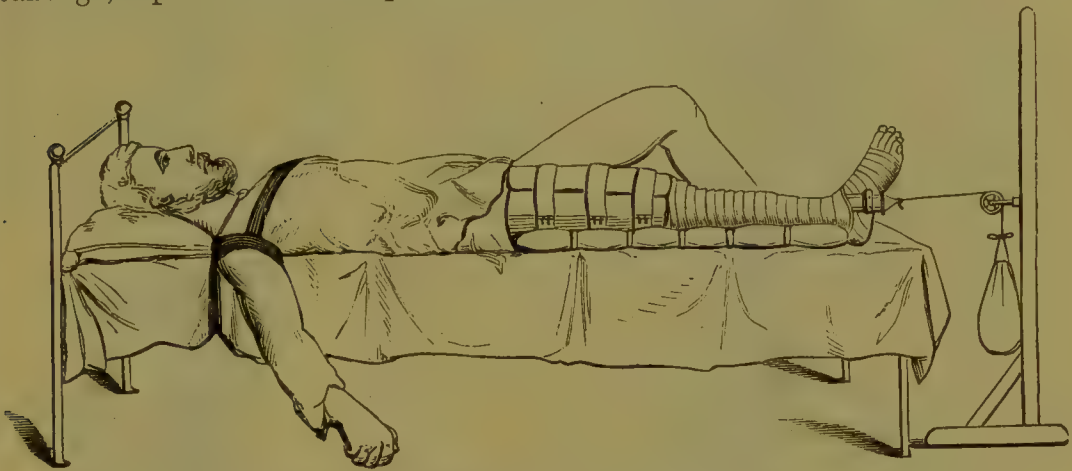


FIG. 121. Extension apparatus for fracture of the thigh. Modified from Gardon Buck, 'New York Medical Record.'

In America the limb is sometimes slung by means of a bent rod adapted to the front of the foot, leg, and thigh, the knee-joint being slightly bent. Hooks are inserted into the back of the rod, so as to sling it from a pulley over the bed. The fracture is carefully set, and the rod then securely bandaged on to the limb. The constant traction of the weight of the leg and foot is supposed to counteract any tendency to shortening. But the plan should only be employed (if at all) when a wound on the front or side of the limb prevents the use of the ordinary splints. Even in such cases it would be better, in my opinion, to put up the limb in plaster of Paris, cutting a hole for the wound.

Now, if we wish to form an estimate of the relative value of these new plans, we have, in the first place, to inquire what has been the result of the old treatment—that by the long splint. I think we may take it as established by consent of all the best writers, that in ordinary cases of fractured femur in the adult with displacement, the result of treatment by the long splint is, as a rule, to leave a certain amount of shortening. Malgaigne, in fact, goes so far as to say: 'When the fragments remain in contact, or

¹ The latest of these plans of making constant extension will be found described by Mr. C. B. Browne, from Mr. Erichsen's hospital practice in the 'Lancet,' October 10, 1874.

when we can replace them, and keep them so by means of their serrations, it is easy to cure a fracture of the femur without shortening; in the absence of these two conditions the thing is simply impossible' (Packard's 'Malgaigne,' p. 581). Without going quite so far as this, I think we may say that every one who has examined limbs treated with the utmost care by our best surgeons with the long splint agrees that if they are measured with perfect accuracy a shortening of at least half an inch is ordinarily found in the adult, but that in children recovery without shortening very often takes place, and is probably the rule. In children, however, the first of Malgaigne's conditions is generally present, i.e. the fragments have never quitted each other, but remain in contact, so that as soon as the limb is straightened it is found to be the same length as the other. By those who advocate the use of permanent extension, either by the weight or elastic springs, this defect is attributed to the indisputable fact that the long splint can make no active extension, and that the bandages by which it is fixed must relax to such an extent as to prevent the extension made at the moment of 'setting' from being accurately maintained. But it must be admitted that up to the present time we have obtained no reliable evidence that the treatment by permanent extension gives any better results, and it may also be said that in fact the results of the long splint, though not mathematically perfect, are usually good enough for all practical purposes; for though a slight amount of shortening may in almost all cases be detected by measurement, its amount in careful hands is not generally so great as to be perceptible to the patient, since it is corrected by a slight involuntary inclination of the pelvis, and he walks without limping.¹ It is in the more formidable cases, in which the fractured ends have been greatly displaced, or where the fracture is double or comminuted, that the shortening becomes really a deformity, and it is yet to be proved that in such cases permanent extension could be so applied as to remedy this displacement, or that if applied it could be tolerated by the patient; for it must be remembered that permanent extension is much more likely to produce ulceration of the skin than the ordinary method, and affords, as it seems to me, much less security against angular deformity. At the same time I have often used extension by means of a weight as an adjunct to the ordinary treatment, and I think with manifest advantage, when there is much displacement in comminuted and oblique fractures.

The method of putting up fractures of the thigh at once is very applicable in the case of infants and young children. In them the long splint is not well borne, and the bandages are constantly soiled with urine and fæces, and require renewal. A starch or gum bandage, or, better still, the leather collar



FIG. 122. Leather collar for the treatment of fracture of the (right) femur in a child. The upper part of the collar is covered with oiled silk, to prevent its becoming soiled with urine or fæces.

¹ It is even possible that the limbs may naturally be of unequal length. A series of sixty measurements undertaken by Dr. Wight of New York ('Arch. of Clin. Surg.' vol. i. p. 283), on males who had had no known injury, convinced him that only one person out of every five has the two limbs of exactly equal length. I may, however, observe that the difference in all but two of Dr. Wight's cases was under half an inch, and that such difference is not more than a trifling error in measurement would account for. Dr. Wight's results are, however, supported by those of a previous investigator.

here figured, will keep the limb straight, which generally is all that is wanted, and the child may be nursed, if in arms. The collar is better than the immovable apparatus, since it can be changed when necessary.

Some surgeons are in favour of treating fractured thigh in young children without any apparatus at all,¹ merely laying the limb in the abducted position flat on the bed. I have treated some cases successfully in this way, but it seems to be exposed to the risk of angular deformity, as evidenced by the preparation represented in Fig. 123; and as all such risks are obviated by the simple plan above described, I cannot see what motive there is for running any such risk, or for the vertical extension of the limb, which Mr.



FIG. 123. Fracture of the femur in an infant fourteen months old, which had been treated without splints. The child died of measles thirty-two days after the accident. The bone is seen to be much bent at the seat of fracture. This malposition was observed and could easily have been remedied before death, had the child's condition admitted of any interference. In another case similarly treated the bone also bent, but was easily straightened, and the cure completed by means of a leather collar. In two other cases the fracture healed well, and without observed shortening.—From Holmes's 'Sur. Dis. of Childhood.'

Bryant recommends.² If the surgeon wishes it, a weight can be hung to the child's foot, at the same time as the collar is applied, but I see no necessity for it.

In the adult a fracture of the femur appears to be sufficiently consolidated to bear the weight of the body without danger in nine or ten weeks. Twelve

¹ See a paper by Mr. Bloxam, 'Respecting the Treatment of Fractures of the Lower Extremities in the Wards under the care of Sir J. Paget,' 'St. Bartholomew's Hospital Reports,' vol. ii.

² Lib. cit. vol. ii. p. 405.

weeks is the usual period during which treatment is continued. Six weeks or more are to be passed in bed, after which, if on examination the union seems firm enough, the immovable apparatus is to be applied, and the patient allowed to move about on crutches for the remainder of the period. When the immovable apparatus is used from the first the patient is spared this confinement to bed; so that Mr. Erichsen, who is the main advocate for its use, says that he scarcely ever finds it necessary to keep patients with simple fracture of the thigh in bed for more than six or seven days. Most surgeons, however, think that the tedium of the confinement to bed is over-balanced by greater safety, and therefore employ some apparatus by which the seat of fracture is exposed: and this involves the necessity of keeping the patient in bed.

In the child under twelve, the period of union and of treatment may be reckoned as about half that of the adult.



FIG. 124. Partial separation of the lower epiphysis of the femur. The part of the epiphysis which forms the inner condyle is detached from the shaft by a fracture traversing the epiphysal line. The fracture then bifurcates—one line running down into the lower surface (inter-condyloid notch of the femur), the other somewhat upward, detaching the outer condyle and adjacent portion of the shaft from the rest of the bone.—From the Museum of St. George's Hospital.



FIG. 125. Another case of separation of the lower epiphysis of the femur complicated with fracture. The line of fracture, after running for about half the thickness of the bone in the line of junction of the epiphysis, then turns upwards into the shaft, leaving a large portion of the latter adhering to the outer condyle.—From the Museum of St. George's Hospital.—See Holmes's 'Surg. Dis. of Childhood.'

Double fractures and comminuted fractures are more difficult to deal with, and require more care in their reduction and treatment, than simple single fractures. In such cases it seems to me undeniable that the treatment by the long splint is much superior to that by permanent extension alone. Compound fracture of the femur is a very grave accident—the danger increasing with age. It is the result usually of gunshot, or of very severe falls, in which the end of the bone is thrust through the muscles and the skin. The first question is, whether to save the limb or amputate. This being settled, on the indications described at p. 126, the limb must be put up in the same way as in simple fracture, only that, if a long splint be used, it must be bracketed, if necessary, at the situation of the wound, which is hardly ever at the posterior aspect of

the limb. The surgeon should be vigilant to detect and give exit to matter as soon as it is formed.

Mr. Morris (op. cit. p. 1021) calls attention to the occurrence of longitudinal and spiral fractures of the femur from torsion of the limb, a form of injury which has been chiefly described by French surgeons—Gerdy, Gosselin, and recently Féré. The latter author believes that he has verified the direction which the line of fracture will take according as the torsion is inwards or outwards; but more extended experience is needed on this head. I have seen this form of injury, producing a long line of fracture with some displacement and much effusion into the knee-joint, together with great increase in the breadth of the femur and much swelling of the whole limb. There may be a good deal of shortening. Union appears to be slow, and the limb is long useless

Longitudinal and spiral fractures.



FIG. 126. Fracture of the femur above the condyles. The seat of fracture is more than 3 inches above the lower end of the bone. The lower fragment is drawn behind the upper and displaced upwards as much as $1\frac{1}{2}$ inch, the antero-posterior diameter of the femur at this part being more than doubled. The callus is formed by two large bridges of bone, between which there is a large tunnel, closed below. The medullary canal of the lower fragment is seen to be patent, and in the specimen the same is found to be the case in the upper fragment also.—From Malgaigne's 'Atlas,' pl. xv. No. 1.



FIG. 127. Fracture of the femur just above the condyles. The fracture runs obliquely downwards, outwards, and a little forwards. The upper fragment, displaced in this direction, has pushed the patella downwards on to the tibia, so that the patella is really dislocated downwards from the femur. The lower fragment remains parallel to the upper.—From Malgaigne's 'Atlas,' pl. xiv. fig. 1.

and painful. The drawings in Mr. Morris's work above referred to give a good idea of the course of these fractures and of the deformity which they may produce.

Fractures of the lower end of the femur are very common. Long fissures run down into the knee-joint from a considerable distance; but the communication with the joint is often a matter only of conjecture, and they heal frequently, as I believe, without any loss of motion in the joint. More frequently the lower end of the femur is separated from the shaft, by a fracture running transversely above the condyles, and often passing vertically down between them into the joint; and in youth (i.e. below the age of nineteen or twenty) the fracture often passes more or less entirely through the line of junction of the epiphysis, constituting what is called a separation of the epiphysis. I

Fractures of lower end.

have shown elsewhere that these separations of the epiphysis are usually complicated with more or less of fracture of the shaft or of the bony epiphysis itself (see page 123), and this is illustrated by the two figures annexed, in one of which the line of fracture runs up into the shaft, and in the other also separates the two condyles from each other. Still there are a few preparations in our museums in which the separation is confined to the epiphysial line. The differential diagnosis of separation of the epiphysis from fracture must be generally conjectural only, resting on the patient's age. It is conceivable that in a pure disjunction of the epiphysis the surgeon might succeed in absolutely diagnosing the injury, by the absence of bony crepitus, together with the mobility of the fragment; but I am not aware that any such case has occurred. The only importance of the diagnosis would be that, if the surgeon could satisfy himself that the epiphysial cartilage had been injured, he might warn the patient or his friends of the possibility of subsequent suspension of growth.

Fracture of the lower end of the femur is in general perfectly easy to diagnose. When the fracture runs transversely across the bone the lower fragment usually falls backwards by the weight of the limb, assisted perhaps by the hamstrings, and the mobility and displacement make the nature of the case obvious. If the separation be as low as the epiphysial line, it involves the knee-joint, which will be more or less swollen; and this swelling may mask the other symptoms. Here also, the fracture being within the knee-joint, the attachments of its capsule hold the bones together, and prevent displacement from occurring, at any rate, to any great extent. But in such cases the loss of power will indicate the probable nature of the injury, and attentive examination under chloroform can hardly fail to elicit definite proofs of it.

When the fracture runs down between the condyles it will often be found that the breadth of the lower end of the femur is perceptibly increased. The condyles may be movable on each other; and an important symptom of fracture running down into the joint is the sensation elicited by rubbing the patella over the condyloid notch. If there be any fracture its unevenness is very plainly felt, in contrast to the smooth motion of the kneecap, in the uninjured limb.

It may be added that in some cases the capsule of the knee-joint, or even the patella itself, has been wounded by the upper fragment.

The treatment of such fractures is usually very successful. The bent position of the limb is best, both for the purpose of relaxing the hamstring muscles and of pushing the lower fragment into position by the projecting angle of the splint. The surfaces are so broad in fractures near the knee-joint that there is probably no shortening, and even when the fracture runs into the joint it often heals without producing any ankylosis. If ankylosis is apprehended it is desirable, after six weeks of rigid rest, to adapt some appa-



FIG. 128. Union of a fracture running down into the knee-joint. The patient, a middle-aged man, recovered with a very useful limb, and died a year afterwards from a different cause. The greater part of the fracture is united by masses of new bone, but there is no new bone in the interval between the fragments of the condyles, and the fragments of the cartilage are united by fibrous tissue.—St. George's Hospital Museum, Ser. i. No. 195.

ratus which can be removed daily or every other day, for the purpose of giving passive motion to a gradually increased degree, in order to obviate such a result. Should ankylosis have taken place it must be treated on ordinary principles, and will often yield to the treatment.

Compound fracture into the knee-joint is an accident which, as a general rule, demands amputation; but to this general rule exceptions may be made in children and in unusually healthy young adults, if the surgeon thinks it justifiable. Mr. Canton has recorded two cases in which he excised the knee-joint for the secondary results of abscess in the joint, after an attempt to preserve the limb, in cases of simple fracture, or partial separation of the lower epiphysis of the femur; but amputation became necessary in both.¹ How far the same operation would be applicable in compound fractures into the joint is doubtful. In cases of gunshot fracture excision has hitherto proved very unsuccessful.

Fracture of the patella is a very common injury, and occurs in two main forms. The ordinary form of fracture is transverse, and is very commonly

Fracture of the patella.

caused entirely by the action of the great extensor muscle, the bone being snapped by the muscle before the patient falls to the ground. But there are many cases (equal, according to some authors, to those caused by muscular action) in which the same transverse fracture is produced by direct violence.² In some cases disease of the knee has preceded and may have been a predisposing cause.³

The fracture, though called transverse, is often more or less oblique. It is accompanied by a laceration of the fibrous tissue covering the bone; and in proportion as this laceration extends completely through the aponeurosis of the extensor muscle the upper fragment is liable to be torn away from the lower by the action of the quadriceps extensor at the moment of the accident, or to be pushed up by the accumulation of blood and synovial effusion in the cavity of



FIG. 129. A transverse fracture of the patella, without laceration of the fibrous tissue in front of the bone, produced by violence acting from within, in a compound fracture of the femur, one of the fragments having, as it seems, been driven against the deep surface of the patella. The cartilage covering the patella is diseased.—From St. George's Hospital Museum, Ser. i. No. 205.

the joint. In some cases the fibrous investment remains entirely untorn, especially when the fracture is the result of direct violence. This is illustrated by Fig. 129, which also shows a peculiar cause for the fracture, viz. the direct impact of a fragment of the femur. Fig. 130 also shows the ligamentum patellæ untorn on one side.

The symptoms are usually very plain. The patient may have snapped the bone before falling, or even with no fall at all (as in Boyer's case, where a coachman snapped his patella in making an effort to hold himself on to

¹ 'Path. Trans.' vol. x. p. 232; vol. xi. p. 195.

² Mr. Hutchinson remarks very truly, 'In the numerous cases in which direct violence is applied to the bone at the moment of fracture, there is almost always muscular contraction simultaneously present, and it is impossible to say which takes the chief share in the result.' 'Med.-Chir. Trans.' vol. lii. p. 328.

³ See Fig. 129 in text; also Packard's 'Malgaigne,' p. 602.

the coach-box. He will be almost or entirely unable to extend the limb; there will be swelling and effusion into the knee, and a depression will be felt between the two fragments, the upper one of which will be movable at

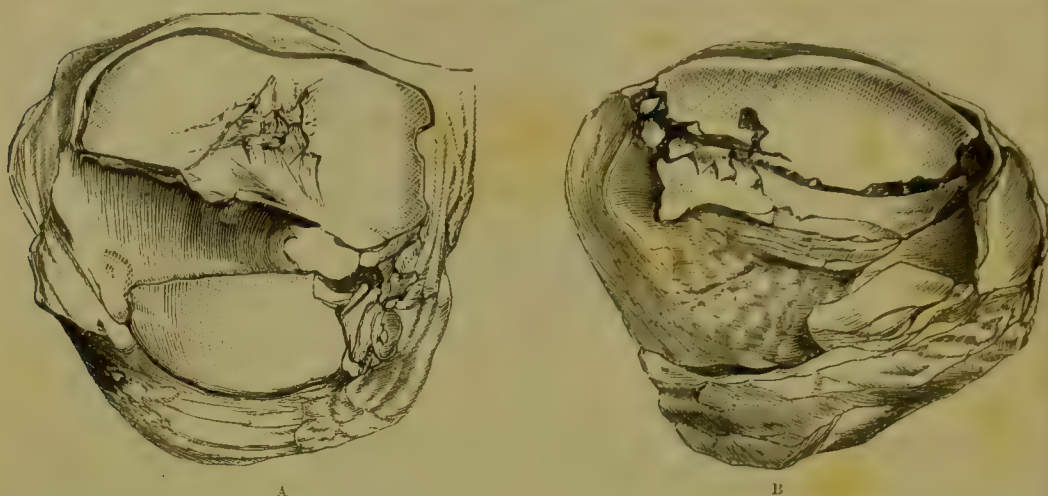


FIG. 130. A specimen of fracture of both patellæ, occurring in a severe injury, from the other effects of which the patient died 50 days after the accident. On one side (A) the fragments were widely separated, and there was no attempt at any union; on the other side (B) the ligamentum patellæ had not been completely ruptured; the fractured ends were in close apposition, and there was some amount of fibrous union. In both the cartilage bears very evident traces of inflammation. No record exists of the treatment beyond the fact that both knees had been put up in pasteboard splints before the final accession of the fatal symptoms, which were due to traumatic encephalitis after fracture of the base of the skull.

a height above that of the upper border of the bone on the other side. Sometimes the bulging of the synovial effusion into the depression can be made out.

Treatment. The foot and leg are to be placed on a straight splint properly padded. It used to be considered essential to raise the foot in order to relax the extensor muscle. But this is now regarded as a matter of little moment, for it has been noticed that after the direct results of the injury have subsided the quadriceps muscle is not contracted, but, on the contrary, quite flaccid and inactive;¹ and it has been found on trial that the results of treatment in the horizontal position of the limb are not inferior to those obtained in the raised position.² Still I am not aware that there is any valid objection

to the raised position of the foot on a comfortable apparatus. I have often questioned patients so treated, who have complained of no inconvenience; but if they do find the position disagreeable I see no use in insisting upon it. The main point is to keep the limb extended and fixed in that position. The next point is to endeavour to bring down the upper fragment and keep it as near the lower as possible. This is often very difficult, from the persistence of effusion in the joint, and from the slight hold which can be got on the fragment. I have often employed Maligne's hooks, and have not experienced any bad effects from them. At the same time, cases have been recorded in which suppuration has followed, and even one, I believe, in which it extended into the joint, necessitating amputation. But such ill consequences are so rare as not to constitute, to my mind, any valid objec-

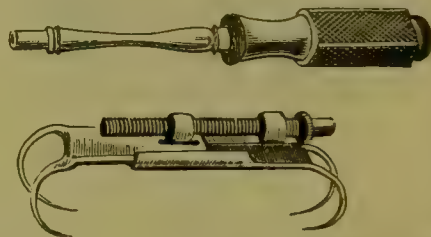


FIG. 131. Maligne's hooks for fractured patella. The hooks are fixed either into the skin and fibrous tissue above and below the fragments, or into plaster firmly applied in these situations, and the upper pair are then gradually approximated to the lower by means of the key and screw.

¹ Hutchinson, op. cit. p. 330.

² Blosam, in 'St. Barth. Hosp. Rep.' vol. iii. p. 386.

tion to the careful use of the hooks. I have found, however, that they have a uniform tendency to displace the lower edge of the upper fragment upwards, so as to render the space between the two fragments V-shaped, the angle backwards. Very close and useful union may, however, often be obtained by their means. It is desirable not to apply them till all active effusion has subsided, but it is not necessary to wait for the entire removal of passive effusion. Another plan—suggested, I believe, by Mr. Callender—which I have found useful, is to hitch under the upper edge of the upper fragment a bandage or strapping, to which a weight is attached, over a pulley at the end of the bed, so as to draw the upper fragment continuously and gently downwards. Numerous other plans have been introduced, but they may all, I think, be comprised under one or other of three heads, viz. : (1) To trust to nature, assisted or not by the raised position of the limb, to bring the fragments as near as is possible on the subsidence of the effusion ; (2) To drag the upper fragment downwards by hooks fixed in the fibrous tissue above it ; and (3) To draw it downwards by the traction of bandages or strapping applied to the skin over its upper end.

Recently, surgeons recognising the importance of the fluid effusion in the joint as a means of separating the fragments, have tested the effect of withdrawing the effused fluid with the aspirator as a preliminary to other treatment. Mr. Heath informs me that this practice has been followed in many cases at University College Hospital with uniformly good results, the fracture being then at once put in a plaster case.¹ This practice has been adopted in St. George's Hospital in many cases with a satisfactory result. In other cases a Martin's rubber bandage and an ice bag have been applied for a few days until the effusion has subsided. Then the middle of a piece of adhesive strapping has been hitched under the upper edge of the upper fragment, and the two ends crossed in the popliteal space, so as to make traction on, and pull downwards this fragment, and the limb put up in an immovable apparatus carefully moulded to the leg and thigh. Fracture of the patella is treated by some surgeons by making a free incision into the knee-joint, drilling the two fragments and uniting them by a strong silver wire, the ends of which are buried in the bone, the whole being done with all possible antiseptic precautions. The advantages that they claim for this plan of treatment is that they obtain bony union and minimise the time required for the treatment of the cure. But it has yet to be proved that bony union possesses any advantage over a close and strong fibrous union, which gives to the patient a thoroughly useful limb. And if it does possess any advantage, it does not seem to me to counterbalance the risk which there must be even in the hands of the most careful followers of the antiseptic treatment. The success of the antiseptic treatment depends on the most careful attention to the minutest details, and if any flaw occurs in any one of these, the wound becomes septic, and the treatment fails. In the hands of a careful operator, thoroughly experienced in this plan of treatment and thoroughly alive to the importance of attention to these minutiae, these flaws or lapses rarely occur, but they do sometimes, and it is the knowledge that such accidents may occur which would deter me from advising this operation. As I have said in another place, 'should I be so unfortunate as to break my own patella, I would not consent to have this operation performed on myself, and I do not,

¹ See the debate on Mr. Croft's paper on the immediate treatment of fractures by the plaster-of-Paris bandage, 'Brit. Med. Journ.' vol. ii. 1881, p. 14.

therefore, feel justified in recommending it to my patients.'¹ In old ununited fractures, where the limb is quite useless and the patient urges the operation, I regard it as appropriate, but it is difficult in such cases to get the pieces of bone into apposition and to retain them there, from adhesions having taken place between the fragments and the joint capsule. This, together with wasting of the extensor muscles and atrophy of the fragments, often renders the result unsatisfactory.

Union.

The union of the ordinary transverse fracture of the patella, in which the fragments have been separated at the time of the accident by a considerable interval, is almost always by ligament, when it unites at all. It is true that many preparations of bony union exist and other specimens are found, as in the annexed figure, where the union appears bony externally, but on section is found to be partly or entirely fibrous. Mr. Morris² has, however, collected four cases in which complete bony union has taken place. One of these is quite conclusive; it was exhibited by Mr. W. T. Wheeler to the Pathological Society of Dublin, who had treated the patient three years previously for transverse fracture of the patella, with $2\frac{3}{8}$ inches separation. Firm osseous union had occurred. Therefore, while admitting the great rarity of bony union after transverse fracture, there can be no doubt that it does sometimes take place. The cause of the ordinary want of bony union is evidently the separation of the fragments, and when that separation has been very extensive it is common enough for the fragments to be entirely ununited. Dr. Macewen³ believes that the 'chief cause of non-osseous union of the patella in cases of transverse fracture is the interposition of fibrous and aponeurotic structures between the fractured surfaces.' He therefore recommends that an operation to elevate the soft structures which lie over the fractured surface should be performed within forty-eight hours of the receipt of the injury, and, further, that it is better to suture the broken fragments together, though he believes that osseous union may be obtained without suturing.



FIG. 132. Union of fracture of the patella with hardly any separation of the fragments. The latter are enormously enlarged in all their dimensions, and their tissue much denser than natural. The interspace between them is filled with dense fibrous tissue, and is not more than one third of an inch in extent. During life the union would have seemed bony.—From a preparation in the Museum of St. George's Hospital, Ser. i. No. 196. Nothing is known about the case beyond the fact that the man was in St. George's Hospital with fractured patella many years before his death.

The length of treatment must be regulated by our opinion as to the state of parts. We must not, on the one hand, keep the knee stiff for so long a time as to risk permanent ankylosis, nor, on the other, allow movement so early as to endanger the yielding of the ligamentous union. When the uniting ligament is short and strong, the knee is very useful indeed; and it is doubtful whether bony union, accompanied as it generally is by much inflammation, is really better for the patient than a firm fibrous union.

As a general rule, the patient ought to be kept in bed for six weeks, and for at least six weeks more he should keep the limb in a splint which will not allow of any bending, after which he may use the leg cautiously, with a laced

¹ Pick, 'Fractures and Dislocations,' p. 275.

² 'System of Surgery,' vol. i. p. 1030.

³ 'Lancet,' Nov. 17, 1883, p. 847.

bandage having an aperture in front to receive the patella; but it must be understood that this time is a minimum. In cases where the separation is at all considerable, a much longer period of complete repose is necessary. The patient need not be confined to bed, but the joint must be kept perfectly immovable for at least six months from the accident. Otherwise the union will gradually weaken and stretch, or perhaps give way altogether.

Mr. Hutchinson has pointed out that after transverse fracture of the patella there is frequently a remarkable wasting of the quadriceps extensor muscle. And that consequently a want of stability and unsteadiness of gait is present, which occasionally results in a fracture of the other patella or re-fracture of the same bone in the effort of the patient to save himself from falling. It is rare, under these circumstances, for the ligamentous union to give way.

The fracture which is purely the result of direct violence is sometimes star-shaped (or Y-shaped) or comminuted, at other times a mere longitudinal crack running more or less vertically. The ligamentum patellæ is generally

Direct, vertical, or Y-shaped fractures.

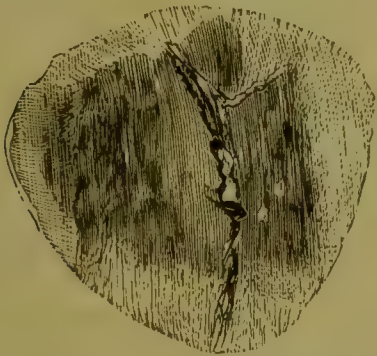


FIG. 133. A patella, showing a vertical fracture running from the base to the apex of the bone, so as to divide it into nearly equal halves. The fracture is joined above by a small oblique fissure ('Y-shaped fracture'), which however is not visible on the cartilage. On looking at the cartilaginous surface the principal fracture is seen to extend through the cartilage into the joint at the lower part only, and when traced upwards on this aspect is found to break up into two principal and numerous smaller fissures, which have no correspondence with the fracture of the bone. The patient, a young woman, had thrown herself out of a third floor window, in a fit of insanity, and died on the following day.—St. George's Hospital Museum, Ser. i. No. 187.

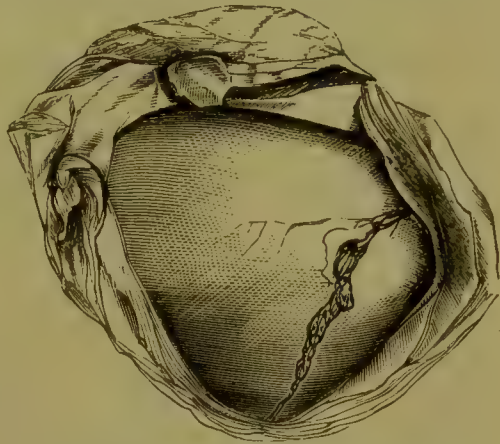


FIG. 134. Internal view of an oblique fracture of the patella, extending downward, from near the base to the apex of the bone. The articular cartilage is also cracked transversely.—St. George's Hospital Museum, Ser. i. No. 186.

untorn, and in fact the fracture often does not correspond on the two faces of the bone, so that no separation of the fragments is possible. There can, therefore, be no doubt that such fractures are susceptible of bony union, and preparations of such bony union exist in the College of Surgeons' and other museums. At the same time, the inflammation caused by the injury is doubtless more deleterious to the motion of the joint than the ligamentous nature of the union in transverse fracture, allowing that in the latter case the bond of union is short.

Compound fracture of the patella is a rare and a very grave accident, usually accompanied by other injuries to the articulation, which necessitate amputation, but occasionally occurring alone, and then allowing the chance of saving the limb. The principles on which the surgeon must be guided in his choice, whether to save the limb entirely, or to excise the joint, or to amputate, are the same in this as in other injuries of the knee. Mr. Poland tabulated all the cases of this injury then on record in vol. liii. of the 'Med-Chir. Trans.,' and even this record clearly shows that in favourable cases the limb may be

Compound fracture of the patella.

preserved, and that very useful motion may often be left. Mr. Turner's summary of the cases recorded since the date of Mr. Poland's paper ('Lancet,' May 8, 1886) is far more favourable. The number of cases was twenty; all recovered, twelve with good movement, five with slight movement, and three with ankylosis—in one case after excision. When the fracture is complicated with other injuries to the joint and surrounding parts so that some operation is necessary, Mr. Poland counsels amputation in preference to excision. But this conclusion is dubious. Mr. Poland himself records a successful excision, and another is given in Mr. Turner's paper. When the limb is to be saved the wound must be accurately united, all loose and completely detached portions having been previously removed, and those which are loose but still attached being left to unite if possible. The fragments should be united by suture, if this seems necessary in order to keep them in apposition. The treatment should be strictly antiseptic. If suppuration comes on free incision is necessary, and now it may be advisable to remove fragments which may have become detached. On the failure of repair, indicated by the non-union of the wound, the grating of the bones under anæsthesia, and the decline of the patient's strength, amputation will be required in most cases.

Fracture of
the leg.

Fracture of the leg is perhaps the most common accident which is met with in our hospitals, since most of the other common fractures are treated as out-patients. It occurs mostly in adult life, children being comparatively rarely the subject of this injury; and as a general rule, when the fracture is simple, the patient recovers with no permanent disablement, though to this rule there are unfortunately numerous exceptions.

The fracture usually occurs at the junction of the middle and lower thirds of the leg, and both bones are usually broken, the fibula often at a higher level than the tibia; the lower fragment is generally displaced backwards, as though drawn by the gastrocnemius. The displacement varies chiefly with the direction of the fracture through the tibia; when this is nearly or truly transverse, there is often little or no displacement; when the fracture runs, as it most frequently does, from above and behind, downwards, inwards, and forwards, the lower fragment is drawn upwards and behind the upper fragment, which projects under the skin in front of the leg and may perforate it. Less frequently the direction of the fracture is reversed, and then the lower fragment is displaced in front of the upper.

There is hardly ever any difficulty in the diagnosis. The cause should engage some attention. Generally the fracture is the result of indirect violence, as in falls on the feet. But it may be caused by a blow or kick on the part itself, which is of course accompanied by more bruising of the soft parts. The treatment is very simple in ordinary cases. The bones, being sedulously brought into exact apposition, are to be kept so for about eight weeks, when the patient may be allowed to use the leg, with merely the support of a bandage. The apparatus for maintaining the bones in apposition are very numerous. It is usual in hospital practice to apply side splints, i.e. two thin pieces of board, properly padded, cut somewhat to the shape of the side of the leg, and provided with a footpiece; or, what is perhaps better, a straight back splint with a footpiece for the sole at right angles to it, and two side splints. These are kept on with straps and bandages, care being taken to see that the heel is well padded, so that the skin is not cut by the bandage, and to see that the foot is at right angles, otherwise the upper end of the lower fragment might be again displaced forward. The patient is then kept

in bed for four weeks, after which the limb is encircled in pasteboard or leather splints for the other four weeks, and he is allowed to move about on crutches with the foot slung from the neck. But it is very common, particularly in the case of persons whose business renders it important for them not to be confined to bed, to put up the fracture in a pasteboard, plaster-of-Paris, or other case, at once, if there is no bruising, or else as soon as the bruising has subsided; and the practice is a safe one, if care is taken in applying the bandage at first, and reasonable precautions observed afterwards to guard against subsequent swelling. I have never myself seen any ill consequences. Yet as the practice certainly involves some risk, in consequence of the withdrawal of the seat of fracture from the surgeon's observation, it may be well to explain this to the patient, and obtain his consent.¹ In fractures with much bruising, or comminution, or displacement, one of the plans recommended below for the treatment of compound fractures may be employed.

Fractures of the tibia alone are much less common, since the force required to break this bone generally fractures the fibula also, and they are usually the result of direct force. The fibula acts as a kind of splint and prevents the separation of the ends, so that there is little, often no, displacement. They must be treated in the same way as fractures of both bones, and are peculiarly appropriate for putting up in a case directly after the accident, provided the state of the soft parts permits it.

Fracture of the tibia.

Fractures of the fibula alone are very common, the usual cause being indirect violence, as a false step or slipping off the pavement, or falling with the foot jammed. The bone is generally fractured near the junction of the lower and middle third, though, especially when the cause is a direct blow, any part may be broken. The diagnosis is not always easy, for there is often no displacement, and the patient can in rare cases even walk.² Whenever a patient is totally or almost entirely unable to walk, and complains of fixed pain referred to a certain spot in the fibula on active or passive motion, fracture may be suspected. The best plan to detect it is to rotate the foot, keeping the fingers of one hand on the suspected part; or to press alternately on both sides of the supposed fracture. The existence of the fracture will be proved either by crepitus, or by the fact that the upper part of the bone does not share the motion impressed on the lower fragment. If the surgeon remains in doubt whether the injury is a fracture or a severe sprain, he should treat it as fracture. When deformity exists there is no difficulty in diagnosis. The deformity consists in eversion or abduction of the foot, which is ascribed by Malgaigne and others to efforts made by the patient to walk, in which the foot, having lost the guard afforded by the external malleolus, is necessarily turned outwards. It is to remedy this displacement that the various formal plans of treatment are designed. Usually nothing is required beyond side-splints, or a case of pasteboard or plaster, since the displacement is easily remedied and there is nothing to reproduce it. The fracture should be kept in apposition for six weeks. The plans which are intended to act decidedly

Fracture of the fibula.

¹ A case was reported some years ago in which a surgeon put up a fracture of the leg (in a young child) in a plaster case immediately after the accident, and allowed the parents to take the child home. The parts swelled and the little patient became uneasy. The parents brought the child back to the surgeon. He was in too great a hurry at the time to make the proper examination by removing the apparatus. The whole skin sloughed, amputation had to be performed, and the surgeon was justly cast in damages.

² I once saw a case in which a patient had been walking, though with pain and difficulty, for some days after a fracture of the fibula. Still more rarely a patient can walk for a time with fracture of both bones.

on the displacement are : 1. Pott's method—the patient being placed on the injured side, with the knee bent to relax the gastrocnemius muscle, the foot inverted, a splint applied to the inside of the leg, not reaching the foot, and a side-splint with a footpiece to the outer side of the leg and foot, the footpiece being more thickly padded than the leg, so as to turn the foot inwards. 2. Dupuytren's method, in which a straight splint is applied to the inside of the leg, reaching several inches below the foot ; a wedge-shaped pad is applied, with its broad end downwards, corresponding to the internal malleolus. The foot and leg are bandaged to the splint, and by making the pad of sufficient thickness any amount of inversion of the foot which is judged necessary to disengage the lower fragment (which is supposed to be locked in or turned towards the tibia) can be secured.

Pott's fracture, or fracture of the fibula complicated with dislocation of the ankle, will be found treated of under the latter heading.

Compound fractures.

When fractures of the leg are compound the injury becomes much graver, and the treatment a matter of more anxiety. Many such fractures prove fatal in the practice of civil life from pyæmia or diffuse inflammation, and in military surgery they are still more fatal. The cause of the accident has much influence on the progress of the case. When, as often happens, the fracture was originally simple, but the patient in trying to move has pushed one fragment (generally the upper) through the skin, there is little or no laceration of the soft parts beyond the mere skin-wound, and there is generally no difficulty in getting the bones back into position with, or even without, a slight division of the skin, which sometimes tightly grasps the protruding fragment. But when the bones have been crushed by a heavy body passing over or striking the limb, and this force has at the same time carried the lower end of the leg backwards, the injury is often extensive and difficult to deal with : the soft parts are greatly contused and lacerated, the bones comminuted, and the comminuted fragments very likely much displaced, so that they can hardly be got into position by any manipulation ; besides which the periosteum is often stripped off the fragments to a great extent, rendering their subsequent death very probable.

The first question is, whether the limb can be saved or no ; the next, whether to remove any of the fractured bone or no.

In resolving to save the limb or to amputate, the surgeon's first thought is as to the extent of laceration of the soft parts, since if this is so great as in his judgment to make traumatic gangrene inevitable, it would be folly to defer an operation which must ultimately follow, and which can never again be performed with so good a prospect of recovery. Again, if either of the main arteries is wounded, it is better to amputate, at least in an adult. In a child or a youth perhaps it might be justifiable to wait till gangrene had commenced. And if the amount of exposed bone be very great, and the patient advanced in years or broken in health, it may be better to amputate. But the experience of modern surgery has shown conclusively how much may be done in saving limbs which would some time ago have been unhesitatingly

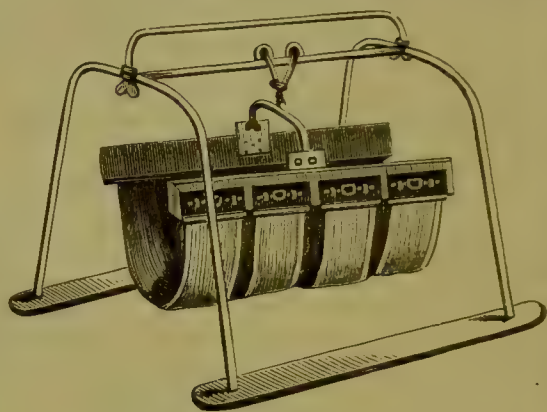


FIG. 135. Salter's swing.

condemned. Many of these cases have been brought to a successful termination by the 'antiseptic' method. The wound should be carefully cleansed and syringed out with carbolic lotion (1 in 20) or some other antiseptic, care being taken that the fluid is brought into contact with all the recesses of the wound. Drainage is then to be provided for, and in some instances it may be necessary to make a counter-opening at the most dependent part of the wound to ensure its being efficient. The limb is to be dressed according to the Listerian method, and placed upon a back-splint with a foot-piece, such as Macintyre's or Assalini's, which will hold the fractured ends securely and

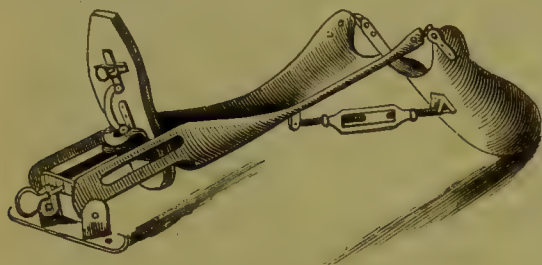


FIG. 136. Macintyre's splint, modified.

In the latter some special contrivance must be extemporised, if the wound is in the calf.

Division of the tendo Achillis has been highly spoken of by some eminent surgeons,¹ as Mr. De Morgan, as a preliminary to the reduction of some simple and compound fractures of the leg, where the upper end of the lower fragment is much tilted forwards and reduction seems to be opposed by the tension of that tendon. The need for this measure may be inferred from careful examination of the limb under chloroform. If the tendon under these circumstances be still rigid, I have no doubt that much good may be obtained by its

division, though in the few instances in which I have myself practised the operation I cannot say that it was successful in obviating deformity; and in one the wound suppurated extensively, and this supuration much retarded the cure.

Finally, I may say that a certain amount of displacement, if un-

attended by much shortening, is not a very grave evil, and that in cases of displaced simple fracture it is better to acquiesce in this result than to run any risk of converting the simple into an inflamed and so into a compound fracture by injudicious attempts at complete reduction.

Fracture of the bones of the foot are singularly rare, considering the great frequency of falls and sprains in that part, showing the efficiency of the protection which the ligaments of the foot afford. They are met with, however, both as the result of direct and indirect force.

The os calcis is fractured from falls on the heel or from the passage of a

Fractures
in the foot.

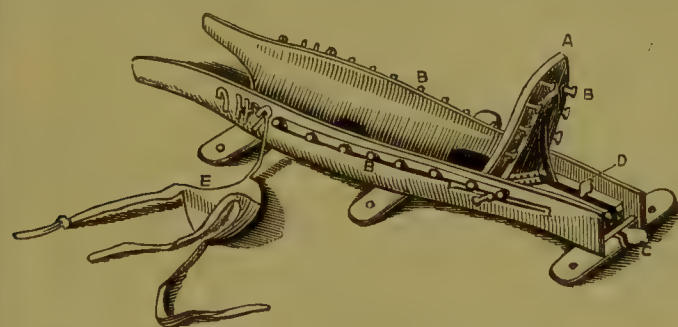


FIG. 137. Assalini's fracture-box. A, foot-piece. B B B, buttons for attachment of straps, bandages, &c., to make pressure as required. C, screw for drawing the foot-piece downwards and so making extension, or increasing it from time to time. D, screw for altering the inclination of the foot-piece. E, a perforated pad attached to the knee, embracing and fixing the patella, and thus making counter-extension.

¹ See the first figure in the chapter on 'Tenotomy.'

wheel over the foot, and the nature of the injury may escape detection. This failure of diagnosis may be of little moment to the patient, since no apparatus is needed to keep the parts in position, and by the time he is able to put the foot on the ground the bone will be consolidated. But usually the increased breadth of the heel will point to the nature of the injury, and crepitus can be detected by proper manipulation. In some cases a fragment may be drawn up the leg by the action of the gastrocnemius.¹ All that is necessary is rest and soothing applications. When the fracture is compound and the fragments are completely severed, it may be well to remove the loose portions.

The astragalus can only be broken by indirect force, and when fractured the fragment is very often dislocated also, leading to the symptoms of dislocation. When this is complicated with a wound (compound fracture and dislocation) the displaced portion should be removed; otherwise the parts should be reduced and kept in position for about six weeks, when the power of standing and walking will probably be regained.

Fractures of the other bones of the tarsus call for no remark; indeed, as separate and distinct injuries they are unknown, though any of the smaller tarsal bones may be implicated in severe crushes.

Fractures of the metatarsal bones and phalanges require only rest, when simple. When compound, the question of amputation is regulated mainly by the amount of the accompanying laceration.

Dislocation
of the hip.

The dislocations of the hip-joint are usually described now, as they were by Sir Astley Cooper, as occurring in four chief directions: 1. Upwards and backwards on the dorsum ilii. 2. Backwards into the sciatic notch. 3. Downwards into the obturator foramen. And 4. Inwards on to the pubes. Other dislocations, called 'anomalous,' are met with, which perhaps would be better styled 'uncommon'; the fact seeming to be (as stated by Mr. Bryant²) that 'there is good reason to believe that the head of the thigh-bone may rest at any point round its socket.'

The following are the features of the common dislocations:—

1. In dislocation on to the dorsum ilii, the limb is considerably shortened, and is inverted, so that the knee points inwards over the lower part of the uninjured thigh, and the toes rest on the instep of the sound foot. The trochanter major is elevated, lying nearer the spine of the ilium than natural, and is turned outwards, so that the buttock is broader and flatter than the other; the head of the bone is to be felt on the dorsum, more or less distinctly according to the fatness of the parts. Voluntary movement is abolished, and passive motion (which, it should be observed, elicits no crepitus) is nearly abolished in all other directions, but may be effected to a slight extent in the direction where the displacement points; i.e. flexion, adduction, and internal rotation.

The diagnosis of this injury is generally very easy—from fracture of the neck of the femur by the fixed position of the limb, the absence of crepitus, and the position of the bone on the dorsum ilii—from dislocation the result of disease by the history of the case—and from the other dislocations by the symptoms which will be immediately described.³ Opinions differ as to the

¹ The tuberosity has been torn from the rest of the bone by muscular action, as evidenced by a case reported by Dr. Anningson of Burnley, 'Brit. Med. Journ.' Jan. 26, 1878.

² 'Bryant's 'Practice of Surgery,' 2nd ed. vol. ii. p. 338.

³ Mr. Morris calls attention to a symptom which he says may always be verified in all dislocations of the hip backwards, whether recent or old—viz., the loss of support from behind to the large vessels in the groin. In some cases the outline of the acetabulum can be made out by firm pressure along the line of the femoral vessels (op. cit. p. 1063).

causation of the various dislocations of the hip. The simplest theory, and one which is powerfully supported by the method of production of these dislocations on the dead subject, is that which Mr. Morris has defended in a very interesting paper in vol. lx. of the 'Med.-Chir. Trans.'¹ It is, that all dislocations of the hip are the result of forced abduction of the femur, and 'that the posterior dislocations result when flexion and rotation inwards accompany abduction' (the sciatic being caused by a greater degree of flexion and inward rotation than that which produces the dorsal), 'and the anterior when extension outwards accompanies abduction, while the downward or thyroid variety occurs during abduction unaccompanied by rotation.' This theory has been questioned by Mr. Eve ('Med.-Chir. Trans.' vol. lxiii.). He inclines rather to the opinion of Sir A. Cooper, that most of the dislocations backwards are *direct*, i.e. that the femur is at the time flexed and adducted, and is then forced directly through the back of the capsule.² Professor Humphry also believes that the dislocation is not indirect, but direct,—the head of the bone being driven through a rent in the capsule, at the lower and back part of the joint, behind the pubo-femoral ligament, and that it occurs commonly when the thigh is adducted, flexed, and inverted. I believe that both methods occur, i.e. that the head of the bone may be driven directly through the back of the capsule while the limb is flexed (its position on the dorsum or in the sciatic notch depending probably on its degree of flexion), or indirectly from laceration of the internal part of the capsule in abduction, the head of the bone being directed on to the dorsum ilii or sciatic notch by the subsequent movements of the limb or trunk; but which is the more frequent method is a very obscure question. The forward dislocations occur, no doubt, in abduction of the limb, the head of the bone being directed on to the pubes, when the patient is at the same time falling backwards, while the foot is fixed, as in Sir A. Cooper's friend, who suffered this injury from falling backwards while his foot was jammed in a hole in the pavement.

Mode of causation of dislocations of the hip.



FIG. 138. Dislocation on the dorsum ilii.

The parts injured in dislocations of the hip backwards are the capsule, the round ligament, the external rotators, to a variable extent, and more rarely the glutei—even in some cases the gluteus maximus and occasionally the sciatic nerve. The psoas and iliacus muscles are put on the stretch.³

Parts injured in dislocation backwards.

The period at which reduction can be effected was fixed by Sir A. Cooper at about two months—and this seems to be true in general—for, though dislocations have been successfully reduced at very long periods after the injury,⁴ it must always be doubtful whether more harm will not be done by the necessary force than the prospect of benefit from the reduction of the bone justifies.

Reduction.

¹ Also in his articles on Injuries of the Lower Extremity, 'Syst. of Surg.' 3rd ed. vol. i. p. 1056.

² 'Lancet,' Nov. 27, 1886, p. 1013.

³ Morris, 'Syst. of Surg.' 3rd ed. vol. i. p. 1060.

⁴ Mr. Erichsen gives reference to several cases in which old dislocations have been reduced. The longest period, however, for the hip is seventy-eight days.

fies. This must be left to the judgment of the surgeon, founded on the symptoms of the case before him, and the result of careful examination under anæsthesia. But it may be observed that the attempt is far more hopeful and far more justifiable, now that anæsthetics are used, than it was in Cooper's time. The obstacle to reduction is not only that the head of the bone will probably have contracted adhesions to the neighbouring parts—for these adhesions will most likely yield to properly applied force—but that the shape of the parts may have changed, the acetabulum being more or less filled with inflammatory deposit, and the head of the femur enlarged by inflammation, and resting in a new socket which it has worn for itself on the dorsum ilii.¹ But this is by no means always the case. Thus, Mr. Brodhurst says that he has found the cotyloid cavity retaining its depth and covered with cartilage after the head of the femur had been dislocated for three years, and refers to a case in which Fournier found the acetabular cavity perfectly natural thirteen years after dislocation; and from these cases he infers that the altered shape of the head can never prevent the return of the bone into the articular cavity.² However, I cannot but believe that inflammatory changes do sometimes go on, both in the dislocated head



FIG. 139. Reduction of dislocation on the dorsum ilii. By Sir A. Cooper's method.

and in and around the articular cavity, which render the secure reduction of the joint impossible; and that the presence or absence of these changes depends in a great measure on the amount of motion of the parts.

There has been a great change in recent times in the proceedings for reducing a dislocation of the hip. Sir Astley Cooper, who was the great authority on this subject, taught that the difficulty in reduction depended mainly on the resistance of the muscles, and prescribed that this resistance should be overcome by traction exercised very much in the line of the dislocated femur. The patient was accordingly to be laid on his back and the limb extended by pulling the knee in a direction crossing the lower third of the opposite thigh; the pulleys being generally used and applied to the femur just above the condyles, while the pelvis was fixed by a perineal band to a staple behind the patient's head. But, since the use of anæsthetics, dislocations are generally reduced without any such expenditure of force, and the success of the 'flexion-method' lends additional probability to Bigelow's opinion, that the obstacle to reduction is to be found, not in the muscles, but in the resistance of the fibrous capsule of the joint, and mainly of that excessively strong part of it which is usually described as 'ilio-femoral,' and

¹ For an example of the enlargement of a dislocated bone, and the new socket formed on the surface upon which it rests, see the head of the radius in the drawing of old dislocation of the elbow, Fig. 98, p. 280.

² 'St. George's Hospital Reports,' vol. iii. p. 70.

which he describes and figures as the 'Y-ligament,' the fibres bifurcating, more or less clearly, below at its attachment to the anterior trochanteric line, so as to resemble the letter Y reversed. The object of this plan of treatment is to endeavour by certain movements of the limb to make the head of the bone retrace the same steps that it has taken in the production of the dislocation, and thus induce it to return through the same opening in the capsule through which it has forced its way.

In all cases the patient must be completely anæsthetised. He is placed on his back on the floor, and the surgeon flexes the leg on the thigh, and the thigh on the pelvis. This flexion is to be carried to its extreme limit; the knee being somewhat adducted and brought well over the middle line of the body. By this means the head of the bone is carried down the back of the acetabulum to its lower part, and the ilio-femoral ligament and ilio-psoas muscle relaxed. This position is to be maintained for some few moments, and then the limb is to be abducted to its fullest extent. This forces the head of the bone inwards to the lower and inner part of the joint, near or opposite to the rent in the capsule, if the dislocation has been produced by indirect violence. The limb is now to be rotated outwards and carried down into the extended position. This will cause the head of the bone to pass through the rent in the capsule and enter the socket, usually with a sudden snap. If manipu-

FIG. 140. Dislocation into the sciatic foramen.

lation does not succeed, the pulleys must be employed; but it seems better to place the patient on his side and make traction on the bent knee (as Sir Astley recommends in the sciatic dislocation), rather than by direct extension to endanger further rupture of the ilio-femoral ligament.

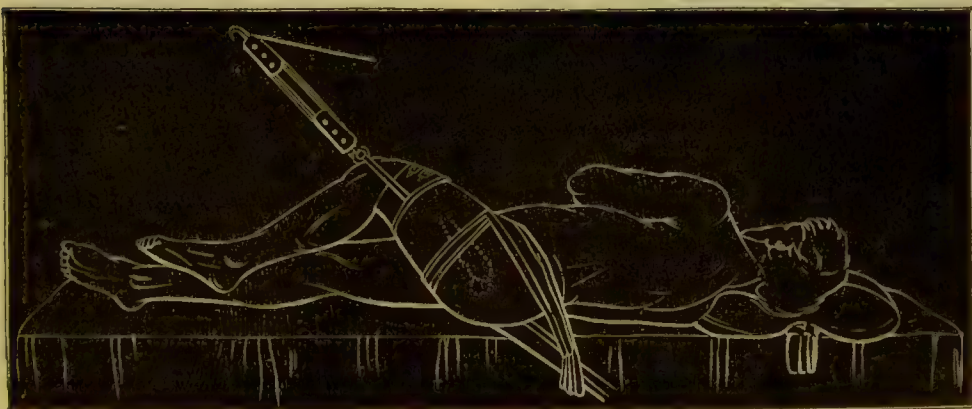


FIG. 141. Reduction of dislocation into the sciatic notch, by Sir A. Cooper's method.

2. Dislocation of the head of the femur into the sciatic notch, or dislocation backwards, is a variety of the dorsal dislocation, and one which, if we adopt Bigelow's views, need not be described separately from it. It is distinguished from the dislocation on the dorsum merely by the symptoms being

Dislocation into the sciatic notch.

less marked; there is less shortening, flexion, and inversion;¹ the knee being only slightly advanced, and the great toe of the affected side resting on the ball of the opposite great toe. The head of the bone is also much less perceptible, from its being sunk more or less into the notch, and from the mass of muscle which covers it, and passive motion is almost abolished except in the sense of flexion, in consequence of the locking in of the head of the femur.

I have described this dislocation according to the accounts left by the best authors, and which, as far as my memory serves, correspond to the phenomena of those dislocations which I have seen, in which the head of the bone has been thought to be in the sciatic notch. At the same time we must recollect that Professor Bigelow has asserted that there is no proof that the head of the femur was really lodged or impacted in the sciatic notch in any case; nor am I aware of any post-mortem examination which absolutely proves that the head of the bone was driven into, or impacted in, the sciatic foramen.

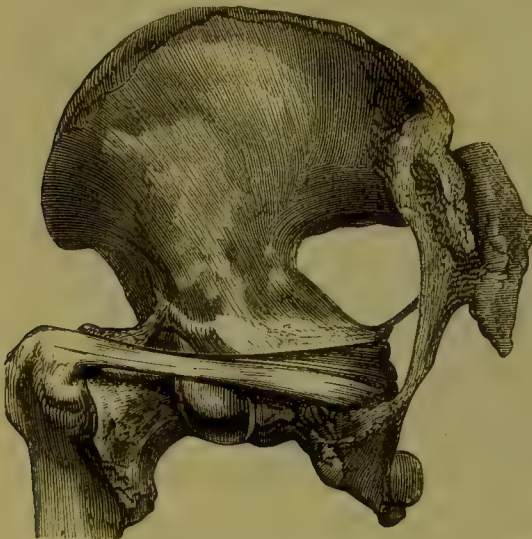


FIG. 142. This figure shows the head of the bone in its socket, with the obturator tendon in its natural position behind it. The part of the capsule which lies beneath the tendon and behind the Y-ligament has been slit, both to demonstrate its thickness and to allow the head of the bone to rise as high as the ischiatic notch.—After Bigelow.



FIG. 143. This figure shows the head of the bone dislocated below the tendon into the neighbourhood of the sciatic notch. If the tendon were not present the capsule would produce much the same effect in binding the head of the bone close upon the ilium without the interposition of the muscle.—After Bigelow.

In the cases referred to by Mr. Quain ('Med.-Chir. Trans.,' vol. xxxi.), as dissected immediately after the injury by himself and B  clard, the head of the bone lay rather between the two notches—i.e. on the spine of the ischium—than in the foramen. In Mr. Syme's case ('Contrib. to Path.' p. 277) the head of the bone was embedded in the torn fibres of the gluteus maximus, 'lying in the great ischiatic notch upon the gemelli and the great sacro-sciatic nerve.' It could not, therefore, have been impacted in the foramen. Nor in experiments on the dead body have I ever succeeded in driving the head of the bone *into* the foramen, though it may easily be lodged anywhere near it; and, in fact, the entire passage of the head of the femur into the sciatic foramen is impossible, from their relative sizes. That Sir A. Cooper's description does not apply to all dislocations called sciatic is plain enough from reading the cases described by Quain, Wormald, and others;² but I think it

¹ There are other cases, however, in which the inversion is even greater than in the dorsal dislocation.

² Mr. Samuel Lee has related an interesting case of dissection of a recent dislocation of the hip backwards, in which the head of the bone was situated below the pyriformis

is going too far to say with Bigelow that the dislocation should not be separately described, or with Malgaigne that it is an invention of Sir Astley Cooper's. Prof. Fabbri has described two kinds of the posterior luxation—one which he calls 'ischio-sciatic,' in which the head of the bone rests just behind the acetabulum, and which corresponds to Bigelow's 'dorsal dislocation below the tendon of the obturator internus,' both in the position of the neck with regard to that tendon and in the great inversion of the limb; while in the other kind, which he calls 'sacro-sciatic,' the head of the bone is carried farther back, so as to lie on the sciatic notch. It is far less perceptible from the surface of the body, and all the characters of the injury correspond exactly to those described by Cooper. The experiments by which these two



FIG. 144. Dislocation into the obturator foramen.

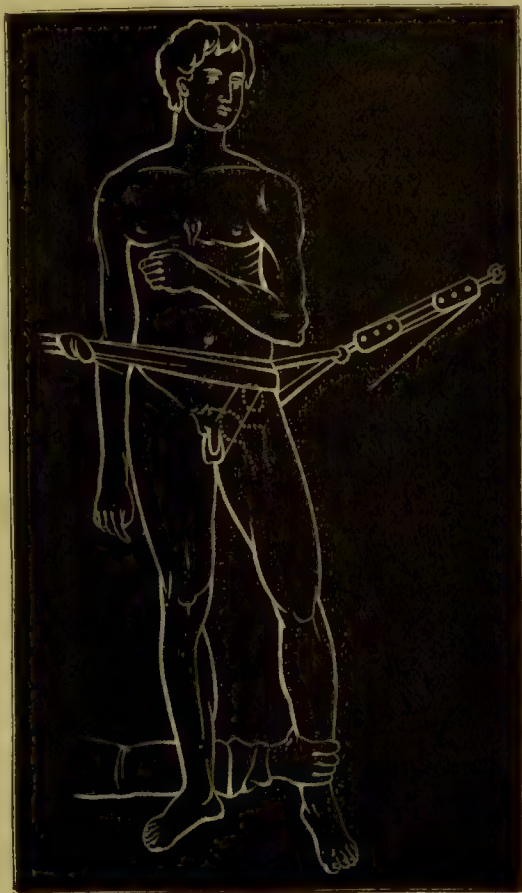


FIG. 145. Reduction of the obturator dislocation. After Sir A. Cooper's method.

forms of dislocation may be produced at will on the dead subject are minutely described in Fabbri's work.

The method of reduction is very much the same as in the dorsal dislocation. Sir A. Cooper directs that the patient be placed on his sound side, and the limb drawn across the opposite thigh—i.e. somewhat flexed—in order to disengage the head of the bone from the notch; and if the flexion be a little more than Sir Astley figures, the method will in all probability succeed. Pulleys, however, are usually unnecessary, since the bone can be

muscle and immediately behind the acetabulum. Here the capsule of the joint was freely lacerated all round, a small portion only remaining attached to the femur in front and behind, and 'in manipulation it was found,' says Mr. Lee, 'that the muscles were the main obstacle to reduction.'—('St. George's Hospital Reports,' vol. vii. p. 169.) See also Mr. Eve's paper, 'Med.-Chir. Trans.' vol. lxiii.

reduced by manipulation quite easily, in the same way as the ordinary dorsal dislocation.¹

Dislocation
into the
obturator
foramen.

3. Dislocation downwards or on to the obturator (thyroid) foramen is a much less common accident than those above described. It is a well-marked injury, differing from all the other lesions about the hip-joint in the fact that the limb is really lengthened,² at least it is so in some cases; while in others (as in one under my own care and another under that of Mr. Rivington³) the lengthening is only apparent, and is due to inclination of the pelvis. The limb is abducted and is also usually somewhat everted. The muscles on the inner side of the limb will be found to be on the stretch, forming, in Fabbri's language, 'a tense cord parallel to the axis of the thigh, beginning at the spine of the pubes, widening as it descends, and disappearing in the middle of the thigh.' There is considerable pain, probably due to stretching of the obturator nerve. The trochanter is less prominent than natural, sometimes forms a deep depression, and the fold of the buttock is lower than on the other side.

I have seen the method of reduction shown in Sir A. Cooper's plates used with prompt success in this dislocation more than once. This method is as follows:—A band is passed round the perinæum, and is hitched under the belt which steadies the pelvis. The latter encircles the two iliac spines, and is fixed into a staple in the wall on the patient's sound side. The perinæal band is attached to the pulleys on the patient's injured side and somewhat behind his head, so that extension draws the head of the femur upwards and outwards, i.e. towards the acetabulum. The surgeon grasps the foot and draws it across the middle line of the body—thus also

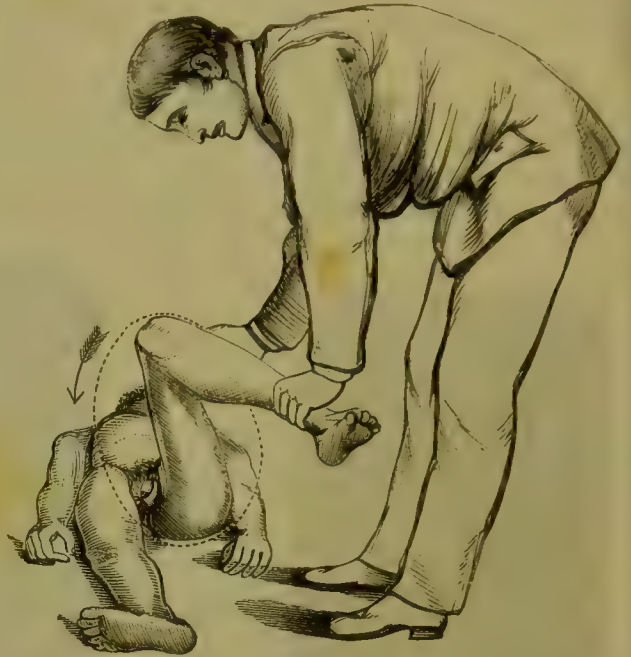


FIG. 146. Reduction of thyroid dislocation by rotating and circumducting the flexed thigh inwards.—After Bigelow.



FIG. 147. The mechanism of the manœuvre shown in the previous figure is here seen. The inner branch of the Y-ligament being wound round the neck, the head must rise towards the socket as the femur is depressed inwards.—After Bigelow.

¹ See a case by Mr. Wormald in which the dislocation was reduced by flexion six weeks after the accident, when pulleys had been used in vain.—'Med. Times,' Aug. 16, 1856.

² In the early stages of hip-disease the limb *appears* to be lengthened, but this appearance is deceptive.

³ 'Med. Times and Gaz.' Oct. 27 and Nov. 3, 1877. The limb may even be shortened. Morris, *op. cit.* 1075.

prising the head of the bone outwards—and reduction is then in most cases easy. The flexion-method consists in the following manipulation: The patient being laid on the floor, the hip is flexed to a right angle, so as to relax the Y-ligament, and the knee is bent acutely, to give a purchase for the surgeon's hands. The limb is a little abducted, to disengage the head of the femur: then the thigh is rotated strongly inwards and adducted, the knee being carried down to the floor. Occasionally, rotation *outwards*, after the limb has been flexed and adducted, will succeed in reducing the dislocation when the above method has failed.

This dislocation may also be reduced by flexing the limb and drawing the head of the bone outwards by means of a towel passed round the upper part of the thigh, or by placing the patient with a post between his legs (the bed-post is generally used) and prising the head of the femur outwards by crossing the foot inwards. Or the limb may be flexed upwards and outwards, and the head of the bone dragged or jerked directly towards the socket. I used this manipulation with success in a case under my care, after attempts by circumduction inwards had failed. The patient was a young muscular man, and the dislocation had only occurred an hour or two previously. Having failed to reduce the bone by the method figured above, I stood over the patient, his pelvis being steadied by assistants, placed my right foot on the horizontal ramus of the pubes, and dragged the flexed thigh directly upwards towards the acetabulum, rotating and jerking it, in order to disengage the head from any intervening obstacles, and lift it over the brim of the acetabulum. After about a minute of this manipulation the head returned into the cavity.



FIG. 148. Dislocation on the pubes.

Bigelow agrees with Sir A. Cooper in stating that in the manipulation of reduction the obturator may be converted into a sciatic dislocation, but he does not seem to see any disadvantage in this. In fact, regarding the dorsal

dislocation (of which the sciatic is a variety) as one easy to reduce, he recommends that in case of difficulty in reducing the obturator dislocation it should be converted into a dorsal, and then reduced as above.

Bigelow also describes several other methods of reducing this dislocation, which I think it unnecessary to quote. From the ease with which the few cases of obturator dislocation that I have seen have been reduced by Cooper's method, I should be myself disposed to have recourse to it when moderate attempts by manipulation in the various ways above described had failed.

4. The last of the four regular dislocations of the hip is that upon the pubes, which, however, is not a common accident. I can only remember seeing one instance of it; and Bigelow, whose experience of these accidents appears to have been large, says he had never met with it in the living body.

Dislocation
on the
pubes.

It seems that the head of the bone may lie either in front of (and more or less upon) the horizontal ramus of the pubes, or on the ilium below the

anterior inferior spine ;¹ and the further inwards the head of the bone has been thrown the further outwards must the lower part of the limb be turned. The main features of this dislocation are the eversion of the foot, with slight shortening, and more or less abduction. The head of the bone being very readily felt will prevent any possibility of confounding this injury with fracture of the neck of the femur.² In reference to the Y-ligament, the dislocation would be described as above the ligament, and Bigelow believes that the eversion, which is so prominent a symptom in this injury, is produced partly by the tension of the obturator internus muscle, but mainly by that of the ligament, which embraces the neck of the bone.

The method of Sir A. Cooper consists in drawing the dislocated limb down in hyper-extension, so as to disengage it from the pelvis, and then by passing a towel under the upper part of the femur the head of the bone is directed towards the acetabulum and lifted over its edge, the limb being rotated inwards at the same time, if necessary, by grasping the knee and ankle.

Reduction by manipulation can, however, usually be effected. The plan consists in flexing the leg on the thigh and the thigh on the pelvis in an



FIG. 149. Reduction of dislocation on the pubes by Sir A. Cooper's method.

abducted position—that is to say, with the knee carried beyond the side of the patient's body. Circumduction inwards, so that the knee is brought to a line parallel to the median line of the body, is now to be performed. The knee must not be carried further than the median line, otherwise it will slip past the socket and become displaced backwards. The head of the bone is now supposed to be at the lower and inner part of the acetabulum, and rotation either inwards or outwards will probably succeed in effecting its reduction. Professor Pirrie recommends the former ; Mr. Stokes the latter plan.

The anomalous dislocations of the hip on record have by this time become

¹ The reader may be referred to an interesting paper by Mr. Cadge of Norwich, in the 38th vol. of the 'Med.-Chir. Trans,' which contains a very clear description and a representation of the dissection of a case, rendered doubly important by the fact that its symptoms are related during life by the younger Travers (in the 20th vol. of the same series), and that it is quoted in one of the editions of Sir A. Cooper's great work (5th ed. p. 95) as an instance of dislocation on the pubes. The head of the bone lay, however, really not on the pubes, but on the ilium, occupying the interval between its two anterior spinous processes ; and Mr. Cadge refers to four other cases, two of them verified by dissection, where the head of the bone was in this position ; and on account of this frequent inaccuracy (speaking strictly) of the ordinary nomenclature, Mr. Cadge would substitute the term 'dislocation under the crural arch,' or 'upwards and forwards,' which would no doubt be more correct.

² Mr. Stokes ('Brit. Med. Journ.' Dec. 11, 1880) mentions two cases in which there was an absence of the characteristic inguinal swelling in consequence of the sinking of the head of the bone into the pelvis.

tolerably numerous. I am not sure that a description of them would be worth the space required. The one which is of most consequence is that variety of the dorsal dislocation in which the limb is everted, called in Italy 'Monteggia's dislocation,'¹ in which the affected limb is crossed more or less over the other and rotated considerably outwards—the head of the bone lies near the anterior superior spine of the ilium, and the trochanter is very prominent. The chief element in the production of this dislocation is, as Fabbri has shown, violent rotation of the flexed thigh outwards, and it can be reduced by a manœuvre not very dissimilar to the reduction of the dorsal dislocation. The limb is to be moderately flexed, slight movements of internal rotation and 'wagging' movements are to be given to it, and, if necessary, the head of the bone is at the same time to be directed by pressure towards the acetabulum.

Unusual or
anomalous
disloca-
tions.

Other anomalous dislocations are those *downwards*, in which the head of the bone has passed beyond the obturator foramen into or near to the lesser sciatic notch,² *backwards and downwards*,³ where it is lodged between the spine of the ischium and the acetabulum; and finally that in which the head of the bone is thrown *forwards* into the perinæum.

Some amount of fracture of the acetabulum tolerably often, as it seems, complicates dislocation. I have already remarked on the point (p. 238), and need only add that the reality of the injury was proved by dissection in Mr. Quain's, Mr. Eve's, and other cases, as well as by almost unmistakable symptoms in many which have not been dissected.

Traumatic dislocations of the *knee* are as rare as pathological dislocations are common—a surprising testimony to the efficacy of the mechanism of the joint, since the articular surfaces are so flat and so little adapted in shape to each other that we should have expected them to have been easily displaced; but the firm capsule, the great tendon in front of the joint, the powerful crucial ligaments, and the strong muscles around hold these large flat surfaces so securely together that we very seldom see even partial dislocation, and complete dislocations are amongst the rarest accidents in surgery.

Dislocation
of the knee.

The usual dislocation is a partial dislocation laterally, the internal articular surface of the tibia being thrown on to the external condyle of the femur, or *vice versâ*. The alteration in the shape of the limb and in the axis of its two parts is so characteristic that the injury can hardly be mistaken, though, as Mr. Holthouse has pointed out, a separation of the lower epiphysis of the femur may at first sight present some resemblance to this dislocation. The dislocations of the tibia forwards or backwards are sometimes complete; and in such cases, particularly when the tibia is carried forwards, the popliteal vessels may be so stretched by the projection in the ham that gangrene may ensue. The nature of the injury is obvious.

Reduction in all these injuries is generally easy, for they are necessarily accompanied by great laceration of the neighbouring structures. If the skin is also torn, so that the dislocation is compound, amputation will be the safest course under ordinary circumstances, though in young subjects and in the simpler cases the surgeon may justifiably make an attempt to preserve the limb.

The patella may be dislocated on to either condyle of the femur, an acci-

¹ Fabbri, op. cit. p. 609. Bigelow, p. 92. Morris, in 'Syst. of Surg.' p. 1072.

² Luke, 'Med. Times and Gaz.' June 2, 1858.

³ Adams, 'Path. Trans.' vol. xxi. p. 305.

Dislocation
of the
patella.

dent which usually occurs from a blow on the part, as from a fall on the edge of the bone, but sometimes from muscular action only. The patella is more commonly thrown on to the outer than the inner condyle; in fact, it is believed that the dislocation inwards is only possible in persons whose ligaments have been previously relaxed.¹ The symptoms when the dislocation is complete are characteristic: 'the articular surface of the patella rests on the outer side of the condyle, with its inner margin directed forwards; the breadth of the knee is increased, the limb is slightly flexed and fixed, and any attempt to move it from this position causes great pain.' If the dislocation is incomplete—i.e. if any portion of the articular surface of the patella remains in contact with the trochlear surface of the femur—the symptoms are less marked, though similar.

In order to reduce the dislocation the quadriceps muscle must be relaxed by flexing the thigh on the pelvis, the body being at the same time bent forwards. Then, if the raised edge of the patella be depressed, the bone will be disengaged, and the muscles will restore it to the natural position. The limb should be placed on a splint for two or three weeks.

Sometimes the patella is dislocated edgewise, either its outer or inner edge being buried between the condyles (usually the former, according to Malgaigne). The dislocation is the result of direct violence, and in some cases much difficulty has been found in reducing it, or it has actually remained irreducible, in consequence of some interlocking of the edge of the bone which is impacted in the intercondyloid notch.

Reduction can generally be effected by the method described above, viz. pressure on the prominent edge of the patella with the thigh flexed on the pelvis. The patient should be placed on his back, with the shoulders raised; the surgeon kneels on the bed facing the patient, with the calf of the injured limb on his shoulder. Both hands are then free to manipulate the bone into its place. If this does not succeed, sudden and forcible bending of the knee, whilst the patient is under the influence of an anæsthetic, should be tried. Subcutaneous division of the ligamentum patellæ and tense bands of the capsule has been resorted to, but does not appear to have been followed, in the recorded cases, by any beneficial results, and is not to be recommended.

The term 'dislocation of the patella upwards' is applied to cases in which the ligamentum patellæ has been torn and the lateral attachments of the patella also so far lacerated as to permit of a considerable amount of displacement upwards. The hollow presented below the patella by the torn ligament, and the exposure of the trochlear surface of the femur beneath the skin, mark the nature of the injury. The treatment is the same as for fracture of the patella. I once had the opportunity of watching a case for some time in which the patient obtained almost, if not quite, complete restoration of the functions of the limb.

Dislocation
of semi-
lunar car-
tilages.

The *semilunar cartilages* are apt to be partially dislocated from the head of the tibia by slight injuries, such as a stumble, or even by catching the toe in the bedclothes, when their attachments have been previously stretched by inflammation of the joint, and their own substance enlarged so as to increase their prominence. The symptoms are sudden and severe pain in the joint, which remains semiflexed and cannot be straightened, with some synovitis. It will be remarked that these symptoms closely resemble those of loose cartilage, and it seems certain that many of the cases described as dislocation

¹ See 'Syst. of Surg.' 3rd ed. vol. i. p. 1081.

of the semilunar cartilages were cases of loose cartilage, while in others the precise nature of the injury is doubtful ; but in the well-marked cases in which the edge of the interarticular cartilage has been felt projecting, and the appropriate manipulations have at once restored the motion of the joint at the same time that they reduced the projection, there is no reason to doubt the diagnosis, and there are two dissected specimens on record.¹ The necessary manipulation consists in completely flexing the knee on the thigh, which can be done gradually, and then suddenly extending the limb fully. As this may be otherwise impossible, Mr. S. Smith of Leeds² recommends that a few feints be first made by extending only to a right angle, and then, when the patient is off his guard, performing the complete extension. If this plan does not succeed, the limb may be bent (under anæsthesia, if thought desirable), and an assistant having placed his arm in the popliteal space, to serve as a fulcrum, the tibia may be drawn downwards as far as possible and rotated slightly. At the same time pressure may be made on the projecting edge of the cartilage with the thumbs. If the reduction is successful, the patient, who could not move his limb before, can at once walk naturally. The treatment after reduction consists in the maintenance of the joint at perfect rest for about three weeks, and this may succeed in restoring the functions of the part. In other cases, and especially when the joint has become to some extent chronically inflamed and the ligaments relaxed, the patient is liable to constant slipping of the cartilage. Recently, many of these cases have been recorded in which a permanent cure has been effected by cutting down on the displaced cartilage, drawing it back into its natural position with forceps, and fixing it there by catgut sutures to the fascia and periosteum covering the tibia.³

Dislocation of the head of the fibula is illustrated by Boyer's case,⁴ in which the whole bone was driven upwards and dislocated at the upper tibio-fibular joint in a case of dislocation of the ankle. Generally, however, this dislocation is a consequence of relaxation of the ligaments. If met with as a substantive injury, the biceps is to be relaxed by bending the knee, and the displaced bone forced downwards. A compress is then to be firmly adapted to the head of the bone and retained there by strapping, while the knee is to be placed on a splint for about three weeks.

Dislocation of the upper tibio-fibular joint.

Dislocations of the *ankle* occur in four different directions. Arranged in the order of their frequency, these dislocations of the bones of the foot are outwards, inwards, backwards, and forwards. The only one which is at all common is the dislocation of the foot outwards, which, as being always accompanied by fracture of the fibula above the malleolus, is called *Pott's fracture*, after the surgeon who first accurately described the injury. The fibula is fractured usually about two inches above its lower end; the internal malleolus is prominent, the deltoid ligament being ruptured; the astragalus undergoes a partial rotation on an antero-posterior axis through its centre, so that its upper articular surface is inclined inwards and the sole of the foot everted. The dislocation is only a partial one. Very frequently,

Dislocations of the ankle.

Pott's fracture.

¹ Fergusson, 'Pract. Surg.' 5th ed. p. 323. Sir W. Fergusson does not say which cartilage was dislocated. Godlee, in 'Path. Trans.' xxxi. 240. In this case it was the external semilunar cartilage which was dislocated.

² In an interesting paper entitled 'On Internal Derangement of the Knee-joint,' 'Lancet,' Sept. 20, 1851.

³ See a case by Annandale, 'Brit. Med. Journ.' April 18, 1885.

⁴ 'Mal. Chir.' vol. iii. p. 883.

however (in fact, I think, usually), the malleolus of the tibia is fractured instead of the ligament being ruptured, so that the injury does not correspond exactly to Pott's description. The cause of the accident is almost always a fall on the foot, in which it is twisted outwards. Reduction is usually easy, by grasping the foot and drawing it downwards (the gastrocnemius having been relaxed by bending the knee and extending the toes), and then manipulating it into position. If pain and involuntary action of the gastrocnemius oppose this manœuvre, an anæsthetic must be given.

Much has been written on the treatment of Pott's fracture. I confess that I have never seen a case which required any other treatment than an ordinary fracture of the leg does—i.e. either side-splints or pasteboard splints for about six weeks; or, if the swelling and inflammation of the joint are considerable, treatment with the part exposed in a fracture-box at first; but cases may occur in which there is some unusual difficulty in keeping the foot at right angles to the leg, and with the sole level (which is the main point in the treatment of this injury), and then it may be necessary to adopt one of the methods recommended by Pott or Dupuytren, for which see p. 312.

Dupuy-
tren's frac-
ture.

Somewhat resembling this injury is the combination of dislocation of the foot outwards with fracture, which is known as 'Dupuytren's fracture.' The foot is displaced outwards and upwards, the fibula is fractured, and the tibio-fibular ligament torn away, or else the tibia is split longitudinally and its fragment displaced along with the lower fragment of the fibula.¹ It differs from Pott's fracture in the fact that there is a complete separation of the articular surfaces of the tibia and astragalus.

Dislocation
of ankle
inwards.

The dislocation inwards is also often accompanied by fracture of the tibia and possibly of the fibula also. It is caused by a twist of the foot in the opposite direction, and requires merely the same treatment as fracture



FIG. 150. Pott's fracture; showing the projection of the internal malleolus, the displacement of the foot outwards, and the depression at the point of fracture of the fibula.

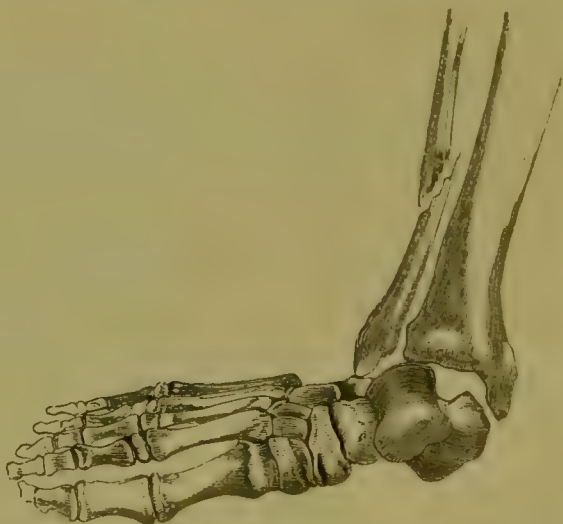


FIG. 151. The skeleton of the foot and leg in a case of Pott's fracture in which the internal malleolus is not injured. After Pirrie.

¹ 'Syst. of Surg.' 3rd ed. vol. i. p. 1092.

of the leg, after the parts have been carefully reduced, for which purpose anæsthesia may be necessary.

Dislocation of the foot backwards occurs occasionally as the consequence of a violent shock on the fore part of the foot, or a fall backwards with the foot in a hole, and, like other dislocations of the foot, is often complicated with fracture of the malleoli. The accident is easily recognised by the shortening of the dorsum of the foot and the relative positions of the leg and heel on the two sides. The toes are generally pointed downwards. Reduction is generally easy, but the tendo Achillis, according to Mr. Bryant, sometimes requires division before the parts can be kept in position.¹

The opposite dislocation—that of the foot forwards—is still more rare. The heel is, of course, shortened more or less as the dislocation is more or less complete. It is distinguished from fracture low down, with displacement, by the position of the malleoli, which would, of course, be carried away with

Dislocation
of ankle
backwards.

Dislocation
of ankle
forwards.



FIG. 152. Dislocation of the foot inwards.
After Pirrie.

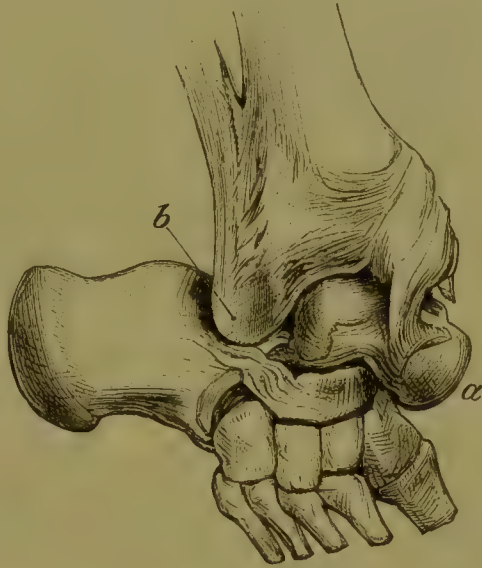


FIG. 153. Partial dislocation of the astragalus forwards; the posterior part of the bone is still in contact with the articular surface of the tibia.

a. The rounded head of the astragalus, projecting on the dorsum of the foot about as far forward as the root of the great toe.

b. The external malleolus, which remains in position, and in front of which is seen the articular facet corresponding to it on the astragalus.—From a preparation in the Museum of St. George's Hospital. Ser. i. No. 212a.

the foot in fracture, and, therefore, retain their natural relation to the heel; while in dislocation they would be nearer to the heel than natural. Reduction has often been found impossible, but the section of the tendo Achillis has been known to facilitate it.²

As a complication of severe injuries the astragalus may be driven upwards between the tibia and fibula; but this can hardly occur without considerable fracture of both of these bones. Still a true dislocation upwards is spoken of by Fergusson and Bryant, and Mr. Morris³ describes a case under Mr. De Morgan's care in which there seems to have been no evidence of fracture.

When these dislocations are compound, amputation used to be considered necessary, till Sir A. Cooper showed that this was not always the case. It

Compound
disloca-
tions.

¹ Bryant's 'Surgery,' vol. ii. p. 350. Cock, in 'Guy's Hosp. Reports,' 1855.

² Poland, 'Guy's Hosp. Reports,' 1855.

³ 'Syst. of Surg.' 3rd ed. vol. i. p. 1094.

remains true, however, that it is very frequently the safest course, though in young healthy persons, where the vessels have escaped damage and there are no other serious complications, the limb and the joint may often be saved. Ankylosis will ensue, but the increased mobility of the transverse tarsal joint will in a great measure compensate for this. In other cases, where there is much comminution, the surgeon may remove the loosened portions of bone, or even excise the whole joint.¹ When the limb is to be saved the wound must be thoroughly cleansed with some antiseptic fluid, free drainage must be provided for, and then carefully closed with equable and gentle pressure. Suppuration should be watched for, and the matter evacuated as early as possible, and such general treatment adopted as the pain or fever indicates. Secondary amputation not unfrequently becomes necessary.

Dislocation
of the as-
tragalus.

Dislocation of the *astragalus*, by which is meant a dislocation of that bone, both from its articulation with the bones of the leg in the ankle-joint, and from those with the os calcis and scaphoid, in the tarsus, is a very severe and dangerous injury. It must not be confounded with that which forms the subject of the next section, viz. the dislocation of the bones of the foot from the astragalus, the *subastragaloid* dislocation, in which the ankle-joint is unaffected. The diagnosis rests upon the unnatural relation between the head or other projecting part of the displaced astragalus and either of the malleoli which may be perceptible. In the subastragaloid dislocation, though the head of the astragalus is unnaturally prominent, it retains its natural distance from the malleoli; but when the astragalus is itself dislocated, in whatever direction the dislocation may have been, this measurement is, of course, altered.

The directions in which the astragalus may be dislocated are forwards, backwards, and to either side, the latter being compound. The dislocation forwards is the most common (Fig. 153). The head of the displaced bone forms a considerable prominence on the dorsum of the foot far in front of its normal position: one or other malleolus is usually buried in the foot; the movements of the ankle-joint are abolished. There may be a wound exposing the displaced bone, and in many cases a fracture co-exists with the dislocation, so that strictly only a portion of the bone is dislocated. The part which retains its natural connections is generally the articulating surface of the head.

In dislocation of the astragalus backwards the posterior edge of the bone presses on the tendo Achillis, the tibia is prominent in front, and the anterior part of the foot appears shortened.²

The lateral dislocations are complicated with laceration of the skin, and often with fracture of the malleolus, though instances are recorded in which the malleoli have been proved to be entire.

Version of
the astrag-
alus.

In dislocations described as forwards or backwards there is almost always some amount of twisting or rotation of the bone. And cases have been put on record in which without any absolute dislocation the astragalus is turned more or less completely on its own axis, whether horizontal or vertical. The latest of these cases is that related by Mr. Barwell in the 66th volume of the

¹ See a successful case of primary excision of the ankle by Mr. H. Lee, in 'Med.-Chir. Trans.' vol. lvii. p. 137. Since the publication of that case Mr. Lee has performed another similar operation at St. George's Hospital.

² B. Phillips, in 'Med. Gazette,' for 1834.

'Med.-Chir. Trans.,' where the reader will find references to the few others on record. In Mr. Barwell's case there was also dislocation of the foot from the astragalus, and a wound exposing the bone, which was excised. In cases of mere version of the astragalus there may be much difficulty in forming a diagnosis; but if the nature of the displacement should be recognised, the surgeon's treatment will be regulated by the amount of concomitant injury. Where, as in Mr. Barwell's case, there is also dislocation of the foot, and the twisted bone is exposed by a wound, I cannot doubt that excision is indicated. In some less complicated cases it might be possible to preserve the bone, whether restored or not to its normal relations.

Simple dislocations of the astragalus ought to be reduced when that is possible. An anæsthetic is usually required, and the patient should be brought fully under its influence. If the entire bone has been driven forwards out of the ankle-joint, it is clear that the contraction of the muscles forming the tendo Achillis has to be overcome before the bones of the foot can be drawn away from the tibia and fibula. The first point, therefore, is to endeavour to effect this by bending the knee and exercising steady traction on the foot, and if this should fail and the tendon is felt firmly contracted, to divide it subcutaneously. If reduction is still impossible, careful search should be made for the anterior tibial tendon, which sometimes slips round the displaced head of the bone and prevents its reduction. If this or any other tendon can be felt on the stretch, it will be well to divide them. Finally, on the failure of all such efforts the case is to be left alone. Instances have occurred in which all has gone on well, union has taken place between the displaced astragalus and the parts around it, and the patient has recovered with a foot lamed, indeed, but quite useful. Usually, however, matters do not go on so kindly. Either suppuration sets in or else (with or without suppuration and diffuse inflammation) gangrene comes on. In the latter case amputation should be at once performed as low down as is consistent with dividing healthy parts. In cases of suppuration unaccompanied by gangrene, in healthy youthful subjects the bone should be excised, and even in those more advanced in life the same course is perfectly defensible. A free incision should be so made as to avoid the anterior tibial artery, the bone should be denuded sufficiently to afford a firm grasp for the lion-forceps, by means of which it should be twisted out of its bed, any remaining attachments being divided, and care being taken to avoid the tendons, vessels, and nerves. Recovery is marvellously complete after this operation. I have seen patients who were able to walk almost if not quite as well and as far as before the injury.

In cases of compound dislocation the choice generally lies between excision and amputation, the surgeon being guided by the amount of concomitant injury, and by the state of health and age of the patient. There are even cases in which the injury to the surrounding parts is slight and the patient's condition exceptionally encouraging, where an attempt may be made to reduce the bone and procure its consolidation with the parts around—in which case, though the movements of the ankle will be abolished, the foot will be on the same level as the other. Such an attempt to save the bone could, however, only be justifiable in the most favourable conditions of age and health. As a general rule the removal of the displaced bone is indicated.

The rest of the foot is sometimes dislocated from the lower surface of the astragalus, an injury which was at first confounded with the dislocation of the astragalus itself, and which certainly bears a good deal of resemblance

Subastra-
galoid
dislocation.

to it, both in its symptoms and treatment ; but as the anatomy of the injury is quite different, and there are some important points of difference in its surgical management, it is necessary to bear the difference in mind. A comparison of Figs. 153 and 154 will make it clear to the reader at once. In the former the astragalus has been driven in great part out of the box

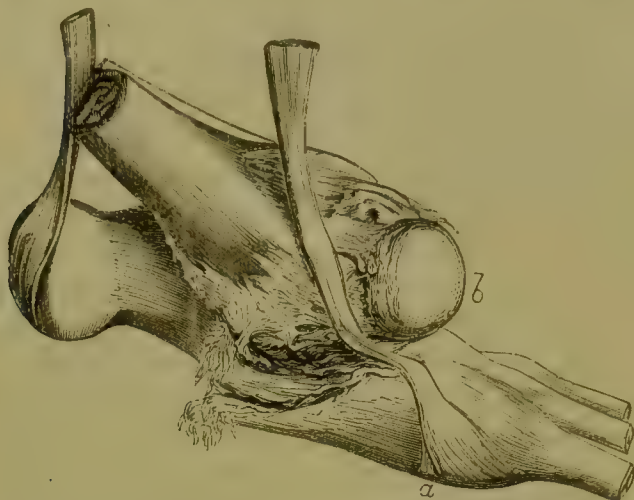


FIG. 154. Subastragaloid dislocation. Mr. Keate's case, described by Mr. Pollock in 'Med-Chir. Trans.' vol. xlii. p. 40. *a*. Tendon of tibialis anticus. *b*. The head of the astragalus projecting beyond and internal to this tendon, which is lodged in the neck of the bone. The astragalus is still in its natural connection to the bones of the leg. Its posterior inferior extremity is pressed into the groove on the upper surface of the os calcis. There is no fracture except of the tip of the external malleolus, which still retains its ligamentous connection with the os calcis. The tendons are seen not to have been divided, and the dislocation remained unreduced. Amputation was afterwards required, but the patient died.—From a preparation in St. George's Hospital Museum. Ser. i. No. 212.

tragalus—which is now usually applied to the injury. The main diagnostic sign, as explained in the previous section, is that the distance between the head of the astragalus and the malleoli or malleolus is normal. This can always be ascertained ; for though one malleolus may be buried in the soft parts, the other is thereby rendered prominent.¹

The foot is displaced usually inwards or outwards, the sole being everted in the former and the external malleolus buried, and *vice versa* in the latter form of dislocation. In the dislocation of the foot outwards, the tibial tendons being displaced, one or other of them is apt to slide behind the head of the astragalus. In Fig. 154 it is the tendon of the tibialis anticus which thus embraces the neck of the bone ; in other cases it has been that of the tibialis posticus, while a case is on record² in which reduction could not be effected until both these tendons had been divided.

Subastragaloid dislocation of the foot either backwards or forwards also takes place, the latter much more rarely, as it seems : or displacement anteriorly or posteriorly is combined with the lateral dislocation. This was so in the case which furnished Fig. 154—the bones of the foot being driven so far backwards that the projecting head of the astragalus rested on the cuneiform bones, and its calcanean facets on the cup-shaped articulating surface of the scaphoid.

¹ In a case quoted by Mr. Pollock, from Sir J. Paget's practice, it is said : ' There was no swelling about the foot or ankle, and the nature of the injury was as evident as it would have been in a skeleton. The astragalus was felt in its normal relation to the tibia and fibula.'

² Quoted by Mr. Pollock in 'Med-Chir. Trans.' vol. xliii. p. 56.

formed for it by the upper articulations of the ankle above, the joint surfaces of the calcaneum below, and that of the scaphoid in front. In the latter, on the other hand, the astragalus retains its connection with the bones of the leg, the ankle-joint is quite intact, and the injury affects only the astragalo-calcanean and astragalo-scaphoid joints. The other bones of the foot are, in fact, driven off from the lower surface and head of the astragalus. Hence the term '*subastragaloid dislocation*'—i.e. dislocation of the os calcis and scaphoid bones from the as-

The treatment of this injury will depend, in the first place, on the presence or absence of laceration of the skin, or of extreme contusion. If the injury be compound, most surgeons hold that amputation is necessary. There are, however, cases in which an attempt to preserve the part may be made, such cases being those in which the wound is a tolerably clean one, the soft parts little injured, and the patient young and in good health. In other cases, where the astragalus is much exposed, or somewhat injured, but the other conditions are favourable, it is right to excise the astragalus. But in the majority of compound dislocations the better course appears to be to remove the foot, which may be done either by Syme's or Pirogoff's method, or by the subastragaloid amputation, if the projecting bone be uninjured.

When the surgeon determines to reduce the dislocation, the patient should be thoroughly narcotised, the knee bent and the foot extended, so as to relax the gastrocnemius as much as possible, and attempts made to manipulate the parts into position. This will often succeed, especially when the foot is dislocated inwards or forwards. But if the tendo Achillis is much stretched, and all attempts at reduction increase its tension, it will become necessary to divide it subcutaneously, and then the dislocation inwards will probably yield to the manipulation. In the dislocation outwards the tibial tendons should next be divided, if they can be felt on the stretch. There are, perhaps, cases in which these tendons may require division, and not the tendo Achillis. Finally, on the failure of these measures, the case should be left to itself, the foot being lightly supported on a splint, and cold sedulously applied to ward off inflammation. On the first appearance or threatening of active inflammation excision of the astragalus should be performed, otherwise amputation may become necessary.

Dislocation of any of the separate bones of the tarsus is an accident of doubtful occurrence. Such accidents have been described, but the correctness of the description is still uncertain, except that the internal cuneiform, it seems certain, is sometimes dislocated along with the first metatarsal bone.¹ Dislocations of the metatarsus affect either single bones, two or more, or finally the whole metatarsus. Dr. R. W. Smith² has recorded two cases in which he found old dislocations of the metatarsus upwards, and has figured and minutely described the appearances both before and after dissection; and Dr. Hitzig has collected twenty-nine cases of various dislocations of the metatarsus, in sixteen of which the whole metatarsus was dislocated, viz. in eleven upwards, in one downwards, in three outwards, and in one inwards. Thus the dislocation upwards is seen to be by far the most common.³ These injuries are usually caused, according to Professor Smith, by a fall or leap from a height, but may also be produced by a weight passing over the foot. The symptoms are obvious; the hinder part of the foot and the ankle are natural; in dislocations of single bones or of part of the metatarsus the toes are correspondingly shortened, and the projection of the displaced bones is quite perceptible; in

Dislocations of the tarsus, metatarsus, and phalanges.

¹ I would refer the reader to Mr. Morris's essay, where he will find a *résumé* of the recorded cases. Mr. Morris admits the reality of dislocation of the os calcis from the astragalus and cuboid bones, and also dislocation of the medio-tarsal joint, of which latter, indeed, he refers to a dissected specimen. 'Syst. of Surg.' 3rd ed. vol. i. pp. 1103 et seq.

² 'On Fractures and Dislocations,' p. 224.

³ 'Berlin. Klin. Wochenschrift.' See an abstract in 'New. Syd. Soc. Bienn. Retr.' 1865-6, p. 273. Three cases of dislocation of the fourth metatarsal bone on to the dorsal surface of the cuboid will be found in the 'Gaz. des Hôp.' Aug. 15, 1876.

the dislocation of the whole metatarsus the whole foot is shortened and the sole rendered convex instead of concave. If the injury is recent, extension and counter-extension under chloroform, with pressure on the displaced bones, will probably succeed in reducing it; but Hitzig wisely deprecates too violent attempts at reduction; and the accounts of several cases show that even if the dislocation be unreduced the foot in time becomes useful.

The toes are but rarely dislocated, and then it is almost always the first phalanx, and is always upwards. The great toe is most commonly the subject of this lesion, and when it is so the same difficulty may be experienced as in the thumb, and probably from the same cause. As the injury is often compound, there would be no hesitation in such a case in removing the head of the bone; but in simple dislocation, if there were much difficulty in reducing it, it would be better to leave it alone. Of the dislocation of the second row of phalanges Malgaigne could find only two examples, and in both the dislocation was compound and was reduced.

CHAPTER XVI.

GUNSHOT WOUNDS.

I NEED hardly say that in a work of this size, intended mainly as an introduction to the practice of civil life, the subject of gunshot wounds cannot be treated at full. Readers who wish to have the whole subject placed before them by the hand of a master will consult Mr. Longmore's 'Treatise on Gunshot Injuries.'

Gunshot wounds are defined as wounds caused by missiles projected by the force of an explosion, and they are therefore sometimes divided into those which are *direct*, i.e. caused by a body which (like the bullet or the fragment of a gun which has burst) is projected by the force of the explosion itself; and *indirect*, i.e. caused by some body (such as a splinter or a fragment of a wall) which has been set in motion by the projectile.

Gunshot wounds are lacerated and contused in the highest degree, and formerly were almost inevitably followed by suppuration and sloughing. Then the introduction of septic matter from without, the insanitary conditions under which the patient was placed, and the too frequent interference with the wound rendered the occurrence of suppuration all but certain. In the present day, however, the more perfect knowledge of the treatment of wounds and the greater attention which is paid to sanitary arrangements render the healing of a gunshot wound without suppuration by no means an uncommon event, and even in cases where it does occur, the local and general symptoms are very much less than they were in no very distant times. No doubt, also, this possibility of primary union has been increased by the introduction of the 'modern arms of precision,' which project their bullets at a greatly increased speed, so as to cut through the tissues more like a knife (a result to which the conical shape of the bullets also contributes), instead of tearing and contusing them, as the old bullets always did, since these latter rapidly lost their velocity as they traversed the tissues. But as respects the fatality of gunshot injuries any slight diminution in the tendency to sloughing in the track of the wound which may be occasioned by the use of rifled arms is far more than counterbalanced by the great increase of force acquired by the projectiles used in modern warfare. It is not only that their great speed enables them to pass through the body of one man after another when standing in a mass—a result to which their lower trajectory also much contributes, and therefore that they cause many more wounds in proportion to the number of bullets discharged—but also the wounds inflicted on each individual are more grave. For the old round bullets used to be constantly deflected by the edge of a bone, a tense fascia, a muscle suddenly starting into action, and thus the subjacent viscera often escaped, so that a ball might enter at the front of the chest and pass out at the back, and yet the track might be entirely outside of the ribs. No such obstacles avail to check or turn aside the course of the newly-invented rifle-balls; the bones are shattered, and their fragments are the source of complicated mischief; the viscera more rarely escape, and the bullet often passes through a limb thrown in front of the body into the trunk, or *vice versa*. The old distinction also

Mode of
union.

Wounds of
entrance
and exit.

which used to be made between the wounds of entrance and exit is inapplicable in those made by such projectiles at their full speed. Bullets which are moving at moderate speed are so checked and slackened as they pass through the tissues that when they emerge they tear and turn outwards the parts through which they pass. The entrance wound is comparatively small, and either flat or inverted; the exit wound is much larger, more lacerated, and its lips everted. (Longmore, p. 107.)

'Wind con-
tusions,' or
contusions
from ob-
lique im-
pact.

There are gunshot injuries which are unaccompanied by any skin wound. These used to be called 'wind contusions,' and were supposed to depend on the mere windage of the ball, but now they are referred to oblique impact, since it has been abundantly shown that balls may pass so close to the body as to cut the clothes without producing any injury, provided they do not touch. These gunshot contusions are often very grave injuries, for though the skin is not broken the muscles and other deep parts may be so disintegrated that death may ensue or traumatic gangrene speedily follow. Gunshot wounds are often complicated by the lodgment of the bullet, or of a fragment of it, or of pieces of the clothes or articles which the patient has had about him, or foreign substances from without, or even of portions of a comrade's body. Lodged bullets may travel to a considerable distance without any obvious symptoms, or they may remain quietly embedded, or encysted, though in the latter case, if in the neighbourhood of important and sensitive organs (such as a nerve), any slight movement or attack of inflammation may renew the painful symptoms first produced by the injury. Wounds from cannon-balls and from fragments of shells often produce the most extensive and ghastly mutilations.

Lodged
bullets and
foreign
bodies.

Examina-
tion of the
wound.

A common gunshot wound is divided into the wound of entrance, the track, and the wound of exit. Sometimes the bullet splits, and there is more than one wound of exit, or a portion may lodge whilst the rest passes out. From this circumstance, and from the much more common lodgment of foreign bodies, it is always necessary to examine the wound, whether there be an orifice of exit or no. This is best done with the finger, if the size of the wound permits its introduction; otherwise a probe must be used proportioned to the length of the wound. Balls and foreign bodies are as a rule to be removed at once, unless in the judgment of the surgeon the operation for their extraction would cause greater mischief than the symptoms they might occasion if left behind could do.

Symptoms
of gunshot
wounds.

The symptoms of gunshot wounds are of course as various as their situation and extent, but some general remarks may be made on the shock, the pain, and the hæmorrhage which are immediately caused by them. The shock depends a good deal on the state of the patient's mind, and on his nervous constitution, as well as on the part injured. Thus, though shock is usually and doubtless correctly enumerated among the symptoms of a gunshot wound of the lung, yet cases occur where the lung has been perforated without any marked collapse, and again others in which the most severe shock has accompanied a small flesh wound. The pain, again, is very variable, and often in the heat of a battle is perfectly unnoticed: so that a patient is brought in as suffering from a single wound, in whom, on examination, a second wound is found of which he has been quite unconscious.

The pain is often referred to the extremity of a nerve which has been injured at some remote part of its course. Thus, Professor Longmore relates the case of an officer who supposed the upper part of his arm had been smashed, and ran to shelter supporting the limb, which he believed was

broken. On examination the wound was found to be confined to the neck, and the sensations were due to injury of the brachial plexus.¹ Hæmorrhage is not a prominent feature of gunshot wounds. The main vessels very often escape injury altogether, even in wounds directly leading down to their course, and when they are hit they are usually so contused and lacerated that they do not bleed. But to this there are of course many exceptions, and there is an impression (which has never been brought to proof) that death on a field of battle very frequently occurs from wounds of the large vessels of the thorax. When a limb is torn off, whether by cannon-shot or otherwise, the main artery is generally seen pulsating up to the point at which it has been torn, and often hanging beyond the surface of the wound, exactly in the same way as when it is drawn out of a stump and twisted. Mr. Longmore says that hæmorrhage, when it occurs, much aggravates the thirst which often torments men who are wounded in the heat of action.

In the treatment of gunshot wounds the first thing is to get the patient Treatment. as soon as possible into a place of security. If he is in a state of syncope it may be proper to give a stimulant at once. Some extemporised support should be arranged for a fractured limb; wounded arteries should be compressed or tied, if they are exposed, or possibly a tourniquet may be adjusted; and where it is possible, an antiseptic pad should be lightly bandaged over the wound. When all this is arranged he is to be removed to the place where the definite treatment is to be undertaken, and then a thorough examination is made, the object of that examination being ‘(1) a correct knowledge of the nature and extent of the wound, (2) removal of any foreign bodies which may have lodged, (3) adjustment of lacerated structures, and (4) application of the primary dressings’ (Longmore). The examination is most easily made immediately after the injury, since then sensibility is numbed, and there is less swelling. The patient should if possible be put in the attitude in which he was when he received the wound, as this will often give valuable hints as to the possible course and place of lodgment of the ball; his clothes should be carefully inspected, in order to see whether any pieces have been carried in with the bullet, and the track should be attentively examined for fragments of the clothes, the bullet, splinters from it or from the bones, and any other foreign substance. No search, however, should be made in wounds penetrating the great cavities of the body. The skin is only to be divided when such division is necessary in order to extract bullets or fragments of shell (of which very large pieces sometimes pass in through a comparatively small wound), or to tie vessels or replace herniated viscera. The old plan of enlarging the orifices of gunshot wounds to obviate retention of matter is quite given up.

The detection of a bullet or lodged foreign body is by no means easy. Fragments of clothes can hardly be detected by any other means than the finger; but very important questions sometimes occur (as in the celebrated case of Garibaldi) with reference to the detection of bullets. It is for such cases as these that the various instruments enumerated by Mr. Longmore² have been invented: Nélaton’s test-probe, in which a small nob of biscuit china is prepared for taking an impression of lead or rust, on being rubbed against a leaden or iron projectile; Lecompte’s ‘stilet-pince,’ in which an arrangement exists for nipping off and bringing away a minute fragment of the foreign body; and the electric indicators of Ruhmkorff and De Wilde, in

¹ ‘Syst. of Surg.’ 3rd ed. vol. i. p. 474.

² Ibid. p. 481. Gunshot Injuries, Sect. VIII. ch. v.

which contact with metal at the bottom of a wound is indicated by the ringing of a bell. I believe I should be right in saying that none of these contrivances have been proved to be of undoubted utility.¹

Coxeter's
Extractor.

For the extraction of lodged bullets numerous contrivances have been invented. That which seems most in favour with military surgeons is Coxeter's extractor. Forceps are also contrived, the blades of which can be introduced separate and then connected together, as midwifery forceps are, while in the wound.

As regards the subsequent treatment of the wound it is very difficult to carry out the 'antiseptic' treatment in all its details under the circumstances of active warfare, but still much may be done by syringing wounds with carbolic or some other antiseptic lotion, cleansing the fingers and instruments with the same, and keeping the wounds thoroughly drained and applying some of the simpler forms of antiseptic dressing, as pads composed



FIG. 155. Nélaton's probe. The bulb at the end is of white china.



FIG. 156. Coxeter's extractor.

of absorbent wool impregnated with iodoform or corrosive sublimate. Or the part may be irrigated with some antiseptic solution. If the wound is small and the edges not much lacerated or contused, and especially if it involves a fracture or implicates a joint, the antiseptic treatment should be, if possible, much more thorough, and time will be well spent by the surgeon in rendering the wound as aseptic as he can and in carefully dressing it on the most approved antiseptic principles. For even if he is not able by these means to keep the wound perfectly aseptic, the local and general symptoms will be most materially minimised.

The constitutional treatment should be simple and supporting. The wound heals gradually after the separation of the sloughs from its track; and during this separation secondary hæmorrhage may occur, and is the more to be apprehended the nearer the ball has gone to the known course of a large vessel. It may sometimes be advisable under such circumstances to leave a tourniquet loosely applied, in charge of the attendant, with instructions to screw it down if the vessel should begin to bleed. If hæmorrhage occurs,

¹ With regard to the use of Nélaton's probe, since much stress is sometimes laid on using it—and in a late trial at Dublin the surgeon was severely censured for not having done so—it may be right for me to record an error into which I was led by trusting to it. A man was admitted into St. George's Hospital under my care, in whom the bullet of a small pistol had passed into the foot from above. A small wound over one of the metatarsal bones exposed some smooth hard body. The question in this, as in Garibaldi's case, was whether this was the edge of the bone or the bullet. To settle this we employed Nélaton's probe. This probe was used in my absence by two gentlemen on whose accuracy I relied, and who assured me that the metallic film which it brought away was quite distinct, and this I believe to have been the case. On repeating the experiment we could not find any such film. I then cut down and examined the parts, when it turned out that there was no bullet there. It had passed down into the soft tissues of the sole. I have no doubt that in this case the bullet had left a streak of lead on the bone, which stained the probe and thus led to the error.

no time should be lost in cutting down on the artery and tying it above and below, if the state of the part admits. Should it be impossible to find the artery, or should it be so disorganised as not to bear a ligature, the choice lies between compression in the wound, tying the trunk artery above, and amputation. The surgeon would incline to the first alternative in all ordinary circumstances; but if local pressure carefully made has failed, and if the hæmorrhage is urgent, the second alternative, that of tying the main artery at a higher point, may be adopted in the upper extremity in almost all circumstances, and in the lower where gangrene does not seem imminent. In other cases it would be better to remove the limb.

A few points must be noticed in the surgery of gunshot wounds in each region of the body in which their prognosis, diagnosis, or treatment differs in some respects from that of the ordinary injuries of civil life.

Gunshot
wounds in
each region
of the body.

Gunshot wounds of the head are always to be looked on with grave apprehension. Even simple contusions may be accompanied by fatal injury to the brain, and many histories are on record showing the rapidly fatal result of drinking or excitement after injuries which had not been known to involve any deeper mischief than a mere bruise or a small contused wound on the head. Such is the case quoted by Longmore, from the surgical history of the Crimean campaign, of a man who was sent home from the Crimea after a superficial wound of the head, and in whom, after a drinking bout, coma supervened, and he died shortly afterwards. 'Post-mortem examination showed traces of inflammatory action in the dura mater, and just anterior and superior to the corpora quadrigemina was a tumour the size of a walnut, composed of organised fibrine and some clotted blood.' In this case the existence of some mischief was suspected in consequence of persistent headache, on account of which the man was invalided; but a similar result has been known to take place without any symptom having been observed. The same liability to remote and unapparent injury of the brain and other parts renders all gunshot wounds of the skull more serious than similar injuries are in civil life. Thus fracture or fissure may extend beyond the part struck, or the internal table may be fissured and driven in with little or no apparent injury to the external, or the meningeal vessels or the brain itself may be lacerated. Fractures with depression are usually fatal unless the depression is very slight, since the brain is generally injured. And penetrating wounds of the brain are still more certainly fatal. Out of eighty-six cases recorded in the history of the Crimean war none survived. Nevertheless there are instances of recovery in which the ball has either passed out again or has become encysted in the brain, though in the latter instance it may set up secondary inflammation at any subsequent period.

Of the
head.

The treatment is to be conducted on the same general rules as in other injuries of the head. In men previously in strong health both the general and local treatment should be strictly antiphlogistic. Venæsection is of the greatest service in such cases, and the constant application of cold to the head, strict rest in a darkened room, and low diet, are also undeniably requisite. Trephining should, as a general rule, be avoided; at least this seems the opinion of the most experienced military surgeons.

The reader will find the subject of trephining in injuries of the head most ably and fully discussed in Mr. Longmore's article in the 'System of Surgery'; and I think I cannot do better than quote his conclusions, as follows: ¹—

¹ 'Syst. of Surg.' 3rd ed. vol. i. p. 506.

'1. Trephining with a view to prevent anticipated consequences of a gunshot injury of the head, and speculative trephining in general, are not justifiable operations. Thus, the fact of there being a fracture and the bone being depressed is not of itself a cause for trephining. The occurrence of symptoms of compression, of epileptiform convulsions, or of paralysis, shortly after a gunshot injury, does not justify the primary use of the trephine, when the local condition of injury is concealed from view and uncertain. Local treatment and general remedies should be employed in the first place, and should be persevered in for some days, or even for two or three weeks, unless special urgency arises, before trephining is employed.

'2. When there is clear evidence that fragments of bone have been forced down so as to penetrate the cerebral substance—not merely that they are, or appear to be, lying upon the dura mater—and when they cannot be removed by simpler means, the trephine should be used to assist in their extraction as early as practicable, whether symptoms of compression or irritation are or are not present. This applies equally to projectiles or other foreign substances which may have been partly forced into the brain substance and are within reach.

'3. When a patient has sustained a gunshot fracture of the cranium, although the evidence as to the nature of the injury may not be precise, if it may reasonably be inferred that the fracture has been accompanied with depression, or with penetration of the surface of the brain, and the existing symptoms of cerebral compression or irritation not only do not yield notwithstanding the continued employment of remedies, but rather show a tendency to become worse, or the symptoms become so severe that extinction of life seems to be threatened, trephining is justifiable under the hope that it may be the means of arresting or removing the source of local mischief, and so averting the threatened fatal consequences.

'4. Lastly, at a later period, after gunshot fracture of the cranium, with or without distinct evidence of penetration of the dura mater or brain, if, after a considerable period of convalescence, grave signs of cerebral compression or irritation manifest themselves, and these become more and more intensified in spite of other methods of treatment, then the trephine should be employed in the hope of finding the source of compression or irritation localised and within reach of relief.

'5. In any case in which trephining is performed, especially in cases where the dura mater has not been previously exposed by the injury, the operation should be done with strictly antiseptic precautions if possible. The relative immunity from irritation, from suppuration, and the more rapid healing of wounds which have been inflicted in opening the cranium under antiseptic precautions when contrasted with others in which similar treatment has not been adopted, have been demonstrated very conclusively.'

Of the
spine.

Gunshot wounds of the spine are usually complicated with injury of other parts, and the mischief to the column and cord is extensive and probably fatal. Little can, therefore, be done in most cases. There are, however, instances of the impaction of a bullet in or near the laminae in which much good has been done by cutting down and extracting it, so that in any case where there is reasonable ground for suspecting that the bullet has lodged in an accessible situation, it is justifiable to cut down and ascertain whether this is the case; and if the bullet can be felt impacted near the spinous process or laminae its extraction should undoubtedly be attempted. (See Longmore, *op. cit.* p. 509.)

A case occurred some years ago in London in which Mr. Canton succeeded in removing a bullet which was lodged in the upper part of the spinal column, and the patient recovered.¹ The case which occurred in Dublin some years since is also well known, in which Mr. W. Stokes made an attempt to extract a bullet which was lodged in the atlas.² The man died, and the treatment was blamed, but most unjustly, as there is no doubt that such an attempt should be made whenever there are no special counter-indications.

Gunshot wounds of the face are more distressing and horrible than dangerous, that is, if they are limited to the face. Large parts of the features may be shot away and yet the patient survive. But they are liable to be complicated with injury to the skull, pharynx, larynx, or large vessels, which may easily cause death; and there are often very distressing though not fatal consequences from lesions of the eyes, or of nerves, ducts, &c. These wounds are also peculiarly liable to secondary hæmorrhage. It is to be noted, however, that much may be done in the way of saving deformity by replacing parts, even if the whole of the part replaced may not preserve its vitality, so that an anæsthetic should be administered, the torn parts replaced, trimmed up if they are lacerated beyond all hope of union, and sewn together as neatly as is possible. Of the face.

In gunshot wounds of the neck the large vessels often escape injury, otherwise the case terminates fatally at once. When the œsophagus is injured nothing can be done beyond supporting the patient with nutrient enemata, and, when this is no longer possible, endeavouring to convey food into the stomach through the wound till the latter has contracted sufficiently to allow a tube to be passed from the mouth. In wounds of the trachea the opportunity of performing tracheotomy below the wound is sometimes, though rarely, obtained. If, however, the trachea is wounded, but there are no indications of portions of cartilage or foreign bodies being in the trachea, and the patient breathes easily, it is better to let him alone. Of the neck.

The great nerves at the root of the neck may be wounded or contused—and I have already alluded to a case of wound of the brachial plexus—but little can be done in the way of treatment. The reader is referred to the section on INJURIES OF NERVES.

Gunshot wounds of the chest are divided into penetrating and non-penetrating, the latter being those in which the serous membranes (pleuræ or pericardium) are not opened, and the former where they are. Again, in penetrating wounds the contained viscera may be injured or may not. Non-penetrating wounds present few peculiarities. It may be noted that when the ribs are fractured, such fractures are more comminuted than in the injuries of civil life, and that the fragments may wound vessels or be driven into the lung even when the bullet itself has not penetrated. And it should Of the chest.

¹ The 'Lancet,' July 1861. In this case (the details of which are of a most interesting nature) the bullet had been fired from a very short distance, and struck against the spinous process, or some part of the arch, of one of the highest cervical vertebræ. The wounded man felt a momentary shock, and thought himself paralysed; but, on being again shot by his assailant in the face, and losing a good deal of blood, his powers of motion returned, and that to so vigorous a degree that he was able to carry out successfully a dreadful and protracted struggle for his life, which ended in the death of his assailant from repeated blows on the head. A portion of bone exfoliated from the injured vertebræ; but the man recovered completely.

² 'Brit. Med. Journ.' 1871, vol. ii. p. 716.

also be remembered that without penetration, and even without any fracture of the ribs, the lung may be more or less bruised or lacerated.

Diagnosis
of wound
of the lung.

In penetrating wounds the chief point is to decide whether or no the lung has been injured. The symptoms of injury of the lung are shock, hæmorrhage from the wound, hæmothorax, hæmoptysis, dyspnœa, traumatopnœa, and emphysema. These symptoms are of different value in proving the point, and any of them may be present in cases where the lung is not wounded, and absent in cases where it is, so that it may be said that there is no one symptom which is absolutely pathognomonic. Yet the presence of all of them, or of the great majority, or of the leading symptoms in a very high degree, renders it extremely probable that the lung is wounded, and justifies the surgeon in that diagnosis.

Shock in
wound of
the lung.

Shock is a very variable symptom. It is frequently present to a great extent in cases where no serious mischief has been done, and it has been often found absent where the lungs have been perforated. Its presence could, therefore, only strengthen a diagnosis which has been formed upon more reliable symptoms.

External
hæmor-
rhage in
wound of
the lung.

Hæmorrhage from the wound, if abundant, and if there is no large vessel near in the parietes (and there is rarely any such vessel), must come either from the lung or from an intercostal or internal mammary artery within the chest. The direction of the wound and the result of introducing a small spatula or piece of card (if it can be done without risk) into the inside of the parietes will enable the surgeon to form an opinion as to which of these two is the source of the bleeding. Still, by itself external hæmorrhage is only one of the minor diagnostic symptoms of wounded lung.

Hæmo-
thorax.

Hæmothorax, if considerable, usually comes either from the substance or the root of the lung—in the latter case it is almost certainly fatal, and in the former very often is so. Still a good deal of blood may pass into the pleura from a wound of the intercostal arteries without wound of the lung, so that hæmothorax also is not an infallible symptom.

Hæmo-
ptysis.

Hæmoptysis may occur from mere bruising of the lung without any absolute penetration, and therefore does not by itself prove even that the wound has opened the chest. But if hæmoptysis is very copious it renders it very probable that the lung has been wounded; and this is converted almost into a certainty if the blood is churned up together with air into an abundant pink froth, and especially if a similar pink froth escapes from the wound.

Dyspnœa.

Dyspnœa is a very variable sign, and depends in a great measure on the patient's previous condition and other circumstances which it is hardly possible to enumerate; and it is often present in mere wounds of the parietes.

Trauma-
topnœa.

Traumatopnœa, or the passage of air out of the wound, is possible without any wound of the lung; for the pleura having been laid open the air may pass in through the wound as the parietes recede from the lung in inspiration, and then be forced out again as they descend in expiration. It is, however, a symptom which must always excite the surgeon's suspicion; and it proves, at any rate, that the wound is a penetrating one.

Emphy-
sema.

Emphysema is rare in any case, since the wound usually allows the air to pass freely out of it, but otherwise the same observations apply to it as to traumatopnœa.

Treatment
of wounds
of the lung.

From this it will be seen that it is usually possible to form a diagnosis which, if not mathematically certain, yet is practically sufficiently accurate to justify prognosis and treatment. As to the former, the injury is a very dangerous but not an absolutely hopeless one, the dangers being primarily

from hæmorrhage and consequent exhaustion or asphyxia, and secondarily from inflammation. It is, therefore, to the avoidance of these dangers as far as possible that treatment is to be directed. In the first place, collapse, if not so profound as to threaten to prove fatal, should not be interfered with, as it tends to check bleeding and gives time for clots to form. Any vessels which may be accessible must be tied. Strict quiet must be enforced. The application of cold externally may be useful. Opium should be administered in full doses, and internal styptics (such as gallic acid and acetate of lead), though little to be relied upon, may possibly be of service. If the patient is strong enough he may be bled to syncope from a large opening in the vein ('pleno rivo'). No probing or meddlesome searching of the wound is in the least degree justifiable, but foreign bodies which are accessible must be carefully removed, and the finger may be cautiously inserted into the wound to replace depressed or comminuted fragments of bone when there is good reason to believe it necessary. The patient should be put in such a position as is easy to him and will not favour the gravitation of fluid into the pleura; so that he is usually placed on or inclining to the injured side; and the wound is to be lightly dressed. The practice of sealing the wound with a view of repressing hæmorrhage has not proved successful. If blood accumulates in the pleura it must be removed, either by incision or by tapping.

Subsequently, when symptoms of pleuro-pneumonia come on, the main questions of treatment are as to the administration of antimony and as to venæsection. Antimony often affords great relief in wounds of the chest when the patient is strong and florid, and when he finds a difficulty in expectorating the fluid which passes into the bronchial tubes. If given, it should be in small but frequent doses (viz. \mathfrak{m} v.-x. of the Vinum Ant. every three hours).

The use of bleeding in gunshot wounds of the lung was no doubt carried to excess by Guthrie and the older surgeons, yet there can also be no doubt that it often affords the greatest relief and benefit in these as in other injuries of the chest. It may be used, as above stated, primarily in order to induce artificial collapse, though this is rarely done in the present day, since it is believed that the weakness so produced renders the patient less able to bear the subsequent inflammation. At a subsequent period venæsection to a moderate amount is indicated when the dyspnœa is in excess of the shock; that is to say, when the patient is suffering much from oppression, with congested face and lips, and the pulse is firm (still more when it is hard), he will derive great and immediate relief from losing about 10 oz. of blood, and in all probability will be well able to bear one or even more repetitions of the bleeding. But when the face is pale and the pulse small, bleeding will probably only hasten his death.

Gunshot wounds of the heart do not differ from other wounds of the same organ, except in their even more certain fatality.

Wounds of the abdomen, like those of the chest, are divided into non-penetrating and penetrating. Of non-penetrating wounds nothing need be said here. In penetrating wounds the viscera are usually injured, and some collapse is generally present. The diagnosis of the exact nature of the injury is not always easy, and indeed it may be of a very complicated character, the bullet having passed through several viscera, or many coils of intestine, besides having wounded vessels or bones in its course. The diagnosis of the viscus injured must be made from the same symptoms as in other wounds—e.g. the

Of the
abdomen.

hæmatemesis and pain in taking food which accompanies wounds of the stomach, the escape of faecal matter or gas in injuries of the intestines, &c. Penetrating wounds of the abdomen are not always fatal; recovery with or without faecal fistula sometimes ensues. In shell-wounds or other large lacerations the viscera may protrude, either uninjured or wounded. In the former case their prompt reduction is necessary. If wounded intestine protrudes, the surgeon must decide, from a careful examination of the extent and nature of the wound, whether it can be sewn up and returned with any prospect of success, or whether it is necessary to attach it to the wound and make an artificial anus. Lately a very strong opinion has been expressed, especially in America, that all penetrating gunshot wounds of the abdomen should be treated by immediate laparotomy, in order that the bullet or foreign substance should be removed and the wounded intestine dealt with according to circumstances. Mr. Barker¹ records two cases in which he followed this line of treatment, in one with a favourable result, the first successful laparotomy for gunshot wound of the abdomen recorded in this country. He and Sir William MacCormac have together collected fifty-eight cases, with twenty-three recoveries and thirty-five deaths. These tables prove that the mortality is lessened year by year, and that much more desperate cases, may be saved by surgical interference than has hitherto been supposed. Protrusion of the solid viscera with wound hardly occurs except in injuries which are necessarily fatal.

The diaphragm may be perforated by a wound, and phrenic hernia may be thus caused, or the bullet may lodge in the pleura, in which it may roll about loose. Mr. Guthrie was in the habit of teaching that in such cases the proper course was to cut into the pleural cavity in the last intercostal space and extract the ball;² but no case in which that operation has been performed is as yet on record, except where the bullet has been felt; nor does it seem that the diagnosis is quite so certain as would be required for so grave an undertaking. In some cases the irritation of the foreign body lying on the diaphragm has led to constant and spasmodic cough, but in others no such sign of the presence of the bullet has been observed,³ and I think no one would now consider himself justified in cutting down in search of a bullet in the pleural cavity unless he had felt it.

Wounds of the hypogastrum, perinaeum, and genital organs.

A perforating wound in the hypogastrum may involve the bladder. The bladder may be reached either from above the pubes through the peritoneum, or below the reflection of that membrane or through the perinaeum. It may even be reached in the female through the vagina⁴ without any serious injury to the soft parts, and it would be possible that it should be wounded in the male from the rectum,⁵ though in such a case the perinaeum or ischio-rectal fossa must be also injured. If the ball, or a portion of the clothes, should remain in the bladder, the usual symptoms of foreign body or stone will follow, and the usual operation has often been performed with success.⁶ A wound of

¹ 'Brit. Med. Journ.' vol. i. 1888, p. 575.

² Guthrie's 'Commentaries,' 1855, pp. 491-97.

³ See the case of Thain, related by Mr. Poland in 'Syst. of Surg.' vol. i. p. 835. 3rd ed.

⁴ Emmet on 'Vesico-vaginal Fistula,' p. 221.

⁵ There is a striking case described by Sir Prescott Hewett in the 'Path. Trans.' vol. i. p. 152, and of which a preparation is preserved in the Museum of St. George's Hospital, Ser. ix. No. 35, of wound of the bladder through the rectum by the broken upright of a chair, on which the patient fell. There is no reason why a bullet should not pass in the same direction, though I am not able to refer to a recorded case.

⁶ Mr. Dixon gave, in the 23rd vol. of the 'Med.-Chir. Trans.,' references to fifteen cases.

the bladder through the peritoneum will, in all probability, prove fatal; but recovery has often been recorded in wounds which were therefore assumed not to have implicated that membrane. The use of the catheter in penetrating wounds of the bladder is generally indicated, unless the external wound is free enough to provide complete exit for the urine. Whether the catheter should be left in or not will depend on circumstances, such as the ease or difficulty of its introduction, and the irritation which it causes; but it must, at any rate, be used often enough to prevent any distension of the bladder, unless the patient can pass water himself, which is rarely the case. If any foreign body is felt in the bladder its immediate extraction is imperative.

Wounds of the penis, scrotum, and testicles are rare as uncomplicated injuries, and those of the external parts in the female almost unknown. Their treatment involves no special points.

Gunshot wounds of the extremities need only be noticed here when complicated with lesions of bone, or presenting some other peculiarity. The

Of the ex-
tremities.

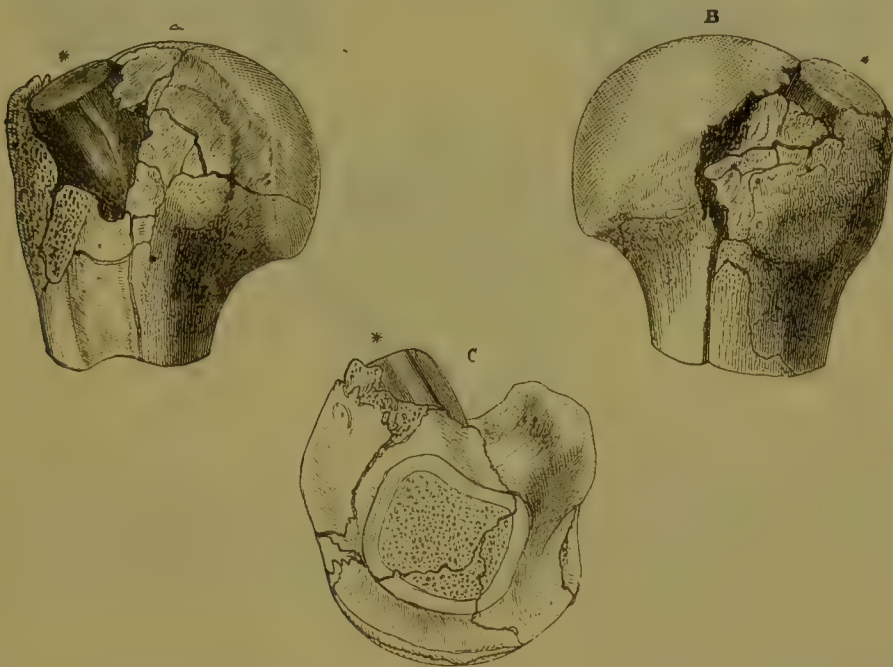


FIG. 157. Injury of the head of the humerus by a conoidal bullet. The bullet (shown by the asterisk *) has entered apex first, and is embedded in the cancellous tissue, its base being on a level with the surface of the bone. Great splintering has followed. A and B show the condition of the head, and C the fissured state of the shaft at the part where the operation of resection has been performed. It is probable that these fissures extended some distance in the shaft below the line of resection.

general rules of surgery are only modified in these injuries by the extensive splintering of the bone which bullets, and especially the conical bullets, cause, and the osteo-myelitis which is so likely to follow,² by the consequences of the sloughing which almost always follows gunshot wounds, and by the circum-

in which this operation had been performed, and with success in a very large proportion of them. He also mentions one in which a small bullet which had passed into the bladder was voided by the urethra.

² Figs. 157, 158, are interesting examples of the great splintering and extensive injury which conoidal bullets inflict on the bones, as contrasted with the more limited effects of round bullets. They also show conditions of the articulating end appropriate for excision, at least in the upper extremity. It seems doubtful whether excision of the knee could be practised successfully if the bone were splintered as in Fig. 157; but it might be ventured on if a bullet were lodged in the head of the tibia or in the femur, and the bone were not splintered, as in Fig. 158.

stances under which the great majority of these injuries are treated. All these peculiarities are very unfavourable for the success of excision, in comparison with amputation, in the lower extremity. For the success of excision of the hip and the knee it seems essential that the bone exposed should be uninjured, the soft parts predisposed to healthy action, and, above all, that the patient should be left undisturbed for a long period. None of these things is so essential in excision of the shoulder or elbow. Accordingly, we find that the two latter operations were brought into general acceptance mainly in consequence of their success in warfare,¹ while the excisions of the hip and knee, although they have sometimes succeeded in war, can count very few

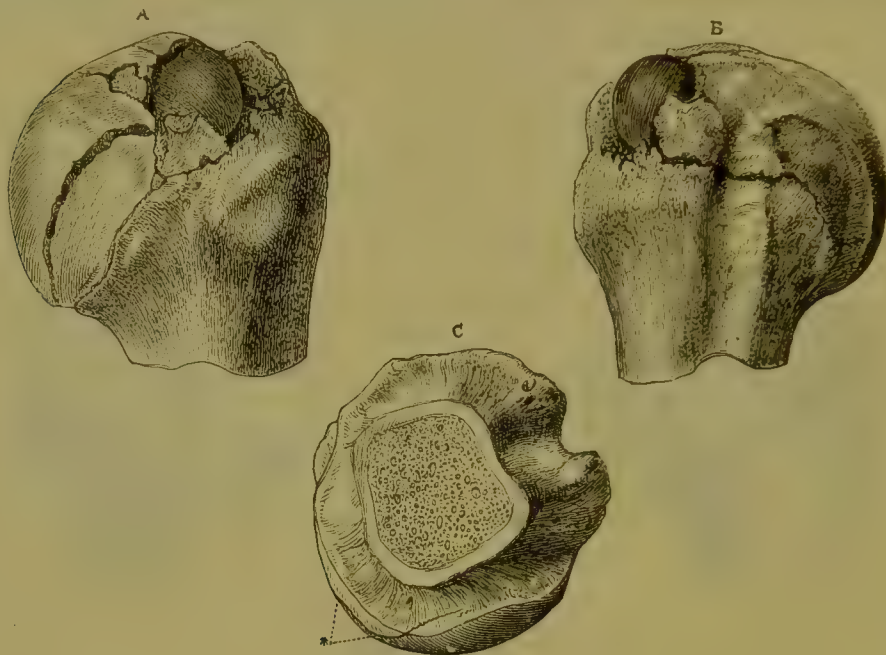


FIG. 158. A and B show the head of a humerus which has been struck by a round ball in nearly the identical spot at which the specimen represented in Fig. 157 has been struck. The round ball, like the conoidal, has also entered to a distance corresponding with its own depth, its surface being on a level with that of the surrounding bone. Although the head of the bone has been greatly shattered, as shown in A, the rending asunder, or splintering, is very limited; and the saw, in resecting the injured head, has passed through the shaft (see C) without crossing a single fissure, and this notwithstanding the operation has been performed somewhat nearer to the neck of the bone than in the preceding instance. The figures represent two preparations, Nos. 2926 B and 2926 D, in the Museum of the Royal College of Surgeons, and are taken from 'Syst. of Surg.' 3rd ed. vol. i. p. 467.

successes either in these or in any other primary injuries. This well-known fact makes a great distinction in the surgery of gunshot injuries in the upper and lower extremities.

The following are, I believe, the main maxims of practice in gunshot injuries of the extremities² :—

I. *In the upper extremity.*— If the lesion of the soft parts does not seem too extensive, do not amputate. Do not perform any formal excision unless the shoulder or elbow is opened, but remove loose fragments of bone, provide free exit for discharges, and put the parts in a favourable position for union. In injuries of the shoulder and elbow, however, the patient has a better

¹ The success of Baron Larrey in excising the shoulder in the wars of the Republic and Empire was one of the first causes of the reception of that operation; while the success of Esmarch in excising the elbow in the war in Schleswig-Holstein, though less striking from accidental circumstances, and although the operation was already a received one, did much to propagate and extend its use.

² It is assumed that the usual rules of practice have been carried out, and foreign bodies if possible removed.

chance of a useful limb if the usual amount of bone be removed by excision ; and the extension of fissures into the shaft of the humerus, or into the bones of the forearm, does not greatly prejudice the chances of the patient's recovery, though in the case of the shoulder the frequency of injuries to the scapula or axillary vessels and nerves is certainly a formidable complication. When, however, along with grave injuries to the soft parts, or with comminuted fracture, the main vessels or nerves or both are wounded, it is usually more prudent to amputate. Yet even in some cases of wound of the main artery in the upper extremity complicated with fracture, if free from other complications, and in a young and healthy subject, the attempt to save the limb may be made.

II. *In the lower extremity* gunshot fractures involving the hip-joint or the upper third of the femur are usually fatal, however treated. Primary amputation is so fatal in these cases that it is almost abandoned. Several cases have recovered under strictly conservative treatment ; a few cases of successful excision are on record ; and secondary amputation has been decidedly more successful than primary. The surgeon must use his own discretion in each case, but all surgeons nowadays have a well-founded horror of primary amputation at the hip, believing that the operation is almost necessarily fatal, while the injury is not so.¹

In gunshot fracture of the lower part of the femur amputation used to be the rule. But it now seems the opinion of the most experienced military surgeons that the conservative treatment yields the best results. All comminuted portions are to be removed and the parts put up in the best apparatus which circumstances permit the surgeon to make ; the wound being treated with the strictest possible attention to drainage, and antiseptic occlusion being carried out as far as may be. Formerly a gunshot wound of the knee-joint was regarded as certain to be followed by extensive suppuration, and amputation was the usual treatment. This is not so now, and many cases have been recorded, especially by Langenbeck during the Franco-Prussian War and Bergmann in the Russo-Turkish War, in which these wounds healed without any suppuration at all. This has been brought about by perfect immobilisation of the joint by means of a well-fitting case of plaster of Paris or some immovable apparatus, and the application of antiseptic treatment and free drainage. Where the injury to the joint is complicated, as it most frequently is with fracture or splintering of the bones, the case is more serious and more likely to be followed by suppuration. But, nevertheless, under conservative treatment a considerable proportion of these cases do well. If the injury has been too extensive to permit of this treatment, excision should be performed or even amputation, especially if perfect quietude and nursing cannot be obtained afterwards.

In gunshot injuries of the leg the limb may often be saved, and in many of these cases the resection of the comminuted bones, and possibly of the portion of the shaft around them, may be advisable. The same observations apply to those injuries in which the ankle has been laid open. In such cases the removal of comminuted portions of bone is often spoken of as an 'excision of the ankle,' and if the term be admitted the operation may be said to be a successful one. Langenbeck is the chief authority in recommending excision of the ankle in military surgery, having operated five times in the Schleswig-Holstein War of 1864, and eleven times in the Austro-Prussian

¹ See Longmore, 'Syst. of Surg.' 3rd ed. vol. i. p. 559.

War of 1866, with thirteen successes and three deaths. In all the cases the periosteum was preserved as far as possible, and the limb put up in a plaster-of-Paris splint at once. But the operation differs from the ordinary excision of the ankle for disease in this very important particular—that the bones of the foot are not diseased and are usually untouched, and that the patient, instead of being a sufferer from chronic disease, is usually healthy. The success of the excision of bones of the leg (called ‘ excision of the ankle ’) for gunshot injury, even if we allow that it has been real—i.e. that the same success could not have been obtained without operation—does not bear on the question of excision of the ankle for disease.

For wounds of the nerves of the limbs I must refer the reader to a subsequent chapter, in which the affections of nerves are treated.

CHAPTER XVII.

TUMOURS.

PERHAPS there is no word in surgical nomenclature for which so many definitions have been attempted, and all of which have proved so unsatisfactory, as the word 'Tumour.' In its strictly etymological sense, it means a swelling; and yet all swellings are not necessarily tumours, though all tumours are swellings. Perhaps as good a definition as any other, and sufficiently accurate to express what we mean, is that a tumour is a swelling 'in which the normal form of the part is widely departed from.' For we need not be concerned in exactly defining the word, since we all understand that, clinically, a tumour is a new growth, which causes a swelling or enlargement in some part of the body.

The cause of the formation of any tumour is, as a rule, entirely obscure. Causes. Pathologists and statisticians have laboured in vain to discover any reason, either in the local or general condition of the body, why an individual should be affected with the growth of a tumour. Developmental errors account for the formation of a small class of tumours; the blockage of a duct may produce a 'retention' cyst; an increase of secretion, or distension of some minute space, may cause other forms of cysts; but with regard to the majority of tumours there is no satisfactory explanation as to their cause. It is true that hereditary tendency is often traceable, especially in malignant tumours, but this affords no explanation, since we know no reason for the original occurrence of the tumours in the first member of the family; nor beyond the vague fact that children usually resemble their parents in constitution and predisposition to disease, as they do in physical appearance and disposition, do we know any reason why the disease, after it has once originated, should be transmitted to succeeding generations. One point, however, in the etiology of tumours is fairly established, and that is, that local irritation affords an explanation for the localisation of tumours and a reason why certain tumours are found in similar sites.

The most superficial acquaintance with tumours will show that there are two well-marked classes of them, separated by broad distinctions. There is one class in which the substance remains limited to the tissue in which it took its origin, in which it gradually increases in size, displacing the structures in which it grows, but not invading them, and producing no other symptoms than those caused by the increasing bulk. These are termed *homologous* tumours, because they resemble more or less completely the normal textures of the part in which they grow. Secondly, there is another class of tumours which extend into tissues of many different varieties and invade all the textures of the part in which they grow; they influence the general health, affect remote parts of the body through the medium of the lymphatics or the blood, and reappear after complete removal. If left to run their course they soften and ulcerate, and cause a profound cachexia, and ultimately death. The former of these groups are clinically termed *innocent*, though, of course, the increase in their bulk may cause death if they are situated in a vital part. The latter are called *malignant*. It must be understood, therefore, that the term 'malignant' is used entirely in Classification.

a clinical sense, and has no reference at all to the anatomical structure of the tumour. By a malignant tumour we mean one which has a tendency to invade neighbouring structures, to reproduce itself in distant organs through the lymphatics or the blood, after it has attained a certain size to soften in its centre and ulcerate on its surface, to return when removed, to produce cachexia, and ultimately the death of the patient. The terms 'malignant' and 'cancer' are therefore not synonymous; for though all cancerous tumours are malignant, all malignant tumours are not necessarily cancers, or (as, perhaps, it would be better to call them, giving them their anatomical term) 'carcinomas.' But though there is no difficulty in placing the well-marked examples of either class under their proper category, it has long been seen that these terms are only relative, and pass the one into the other by insensible gradations. Speaking generally, we find that the malignant tumours are generally the sarcomas and carcinomas, though, as we shall hereafter see, some of the lymphomas, and perhaps some other forms of tumours, are also malignant. As regards the structure of a tumour, and its tendency to assume a malignant aspect, Mr. Savory has pointed out that, speaking generally, 'the less the structures of which a tumour is composed tend to change from their primary or embryonic form the more abundantly will they multiply; so that those tumours whose structures retain most nearly their primary form are the most malignant. And as the structures of the tumours are capable of transformation, so they lose their power of repetition; so that those tumours which consist most completely of fully formed tissue are the most innocent.'

Thus the most lowly organised tumours are the carcinomata, the cells of which show no tendency to grow into any higher forms, and which consist in great measure of juice, which is partly, indeed, the product of the disintegration of the cells, but partly is a new morbid formation; and these tumours show all the characters of malignancy most plainly. Next in order are the sarcomata, in which an attempt has been made at the formation of tissue, although imperfect and embryonic, and these tumours, though unstable in their composition, prone to ulceration, prone to recur after removal, and occasionally making their appearance in distant parts of the body, have all these characters in a far less degree than the carcinomatous tumours have; while the best examples of the purely innocent tumours are such as consist throughout of a highly developed tissue, such as bone. Many of the latter kind of tumours are as stable, and as little prejudicial to the health of the individual, as if they had been original portions of his organism.

Tumours are now almost always classified upon an anatomical basis, and this, though by no means perfect, since it cannot determine the clinical characters of any given tumour or its degree of gravity, appears on the whole to be the best plan which, with our present state of knowledge, we can adopt.

In the first place, all tumours may be divided, according to their anatomical structure, into two great groups: (1) Cystic or fluid tumours, and (2) Solid tumours.

The solid tumours present the far larger proportion and the greater diversity in structure, and bearing in mind Virchow's law, that 'the same types of anatomical structures exist in new formations as are found in the body generally,' this group of tumours are subdivided according to their anatomical structure into four great classes, based solely on their analogy with normal tissues. First, we have those tumours formed of a tissue the type of which is found in connective tissue; secondly, tumours composed of

a tissue analogous to one of the more complex structures of the body, as, for example, muscle, nerve, blood-vessels, &c. ; thirdly, tumours formed of a tissue analogous to embryonic tissue ; and fourthly, tumours in which epithelium or endothelium form the essential part of the new growth.

This classification has the advantage of being purely histological, and of presenting, as far as possible, an anatomical uniformity, and, as will be seen in the sequel, this anatomical uniformity bears a considerable relation to their clinical significance.

Cysts or cystic tumours may be defined as sacs or bags, the wall of which is formed of a membrane of connective tissue, lined by epithelium or endothelium, and containing fluids or semi-solid contents. They must not be confounded with cysts *in* tumours, due to mucoid degeneration of the material of which the tumour is composed and the formation of a cavity in the interior of the tissue. In these the cyst is never surrounded by a proper membrane, with an epithelial lining. Cysts may be divided into—I. Those formed by the distension of pre-existing tubes or cavities. II. Those of new formation. III. Those of congenital or uncertain origin. Cysts.

I. Cysts arising from the distension of pre-existing spaces are usually divided into (a) Retention cysts, and (b) Exudation cysts.

Retention cysts, as the name implies, are cysts where the natural secretion of some gland or duct is prevented from escaping by some unnatural obstruction, and as a consequence is *retained* in the interior of the gland or duct, and accumulating causes an expansion to such an extent as to form a cystic tumour. The best example of this is constantly seen in the 'atheromatous' cyst, arising from stoppage of the duct of an ordinary sebaceous gland of the skin. These are found mainly on the head and face, though most other parts of the surface may be affected, the axilla being remarkably exempt. They are situated immediately under the skin, which is generally movable over them, but in some instances, especially when they occur on the face, is adherent to them. Frequently enlarged vessels may be seen ramifying in the thinned skin over their surface, and their summit is often marked by a dark point indicating the spot where the occluded duct opened. They contain usually inspissated sebaceous matter of a peculiarly offensive odour ; more rarely fluid of various colours, mixed with epidermal scales and cholesterine. The wall of the cyst varies in thickness ; on the scalp it is usually thick and tough and loosely connected to the skin and subcutaneous tissue ; on the face it is much thinner and much more closely connected to surrounding parts. Sebaceous tumours are smooth and rounded on the surface, soft and pulpy to the feel, unless the sac wall is very thick, when they are hard and firm. They project sometimes to a considerable extent beneath the skin, and when they occur on the scalp are often multiple, forming rounded, smooth, bossy swellings of varying size. They grow slowly and sometimes remain stationary for years. When irritated they inflame and suppurate, the skin over them gives way, and the exposed sebaceous matter putrefies and becomes very offensive. Sometimes the cyst wall is thrown off by surrounding suppuration, at other times it becomes thickened and nodulated, unhealthy granulations spring from it, and a fungous sore, which may be mistaken for an epithelioma, results. Occasionally horny growths are formed as a consequence of the exudation of sebaceous matter from these cysts. The secretion dries and forms a scab, fresh exudation takes place beneath it, and thus an excrescence, which becomes of a dark brown colour, and which resembles a horn, is formed. There is in the Museum of St. Cysts arising from the distension of pre-existing spaces.
Retention cysts.

George's Hospital one of these horns, measuring five inches in length, which was removed from the face of an old woman seventy-five years of age.

The treatment of these cases is generally removal. Occasionally they may be cured by opening up the occluded duct with a probe and keeping the sac empty by periodically squeezing out its contents. As a rule, however, if the tumour is large or occasions any inconvenience or deformity, it is better to remove it; if it is small and causes no unsightliness, it may very well be left alone. The operation is usually a very simple one. If the tumour is on the scalp, it may be transfixed with a sharp bistoury and shelled out with the scoop of a director; if, on the other hand, it is on the face, it will probably require more or less careful dissection for its removal. Great care should be taken to remove the whole of the cyst wall. If a portion be left it may reproduce the secretion, prevent the healing of the wound, and cause the formation of a troublesome sinus. It is always desirable in these cases, before performing any operation, to take all adequate precautions to see that the patient is in good health, and afterwards to take care that he does not expose himself injudiciously to any risk of cold or indulge in excess of any sort. The operation should be done with antiseptic precautions, for there is great liability to erysipelas or cellulitis after it, especially when the tumours are multiple and are situated on the scalp.

Other forms of retention cysts are found on mucous surfaces, originating in the same way as the sebaceous tumours of the skin. Such are the cysts in the antrum—'dropsy of the antrum' as it is usually called, arising from retention of the secretion in one of the mucous crypts; one form of ranula; cysts in the labia of the female arising from retention of secretion in one of the glands of Bartholin; or in the male from Cowper's glands. Lastly, retention cysts may be formed by the blocking of some large duct, and the accumulation and retention of the secretion in the duct behind the obstruction, as in the ordinary galactocoele in the female breast.

Exudation
cysts.

Exudation cysts are those cysts which are formed by an accumulation of secretion in some pre-existing cavity, which is not provided with an excretory duct, and in which under natural circumstances absorption goes on as rapidly as secretion, and therefore no accumulation takes place. The various kinds of bursæ, which will be described in the sequel, constitute the most important group of exudation cysts.

Cysts of
new forma-
tion.

II. Cysts of new formation comprise the most important group of cysts and present a very considerable variety. They may be divided into (1) simple serous cysts, (2) blood cysts, and (3) true cystic tumours—that is to say, those tumours where the formation of the cyst is an essential of their existence and growth, not an accidental complication.

Serous
cysts.

The simple serous cyst consists merely of a thin fibrous envelope, lined by flattened endothelium, and filled with serous fluid. They are generally supposed to be formed by accumulation of fluid in the areolar spaces, which then produces by its pressure the stratification of the areolar membrane, and thus becomes encapsuled. Accidental bursæ formed in some situation where there has been friction or pressure belong to this class of cystic tumours.

Blood
cysts.

Sanguineous cysts occur either as a consequence of hæmorrhage into a serous cyst, or from effusion of blood into the areolar tissue, which becomes condensed around the effused blood, forming an ill-defined capsule around the extravasation, or from the effusion of blood into a tumour, the substance of which, expanded over the collection of blood, appears like a cyst. This was the case in the instance from which the illustrations (Figs. 159 and 160) were taken.

The patient, a man aged 30, was under my care at St. George's Hospital, in consequence of repeated hæmorrhages from the large tumour which is shown growing from the outer side of the leg, and which is seen to be ulcerated in several places. The whole mass was excised, and was at first thought to be a simple cyst filled with blood, but minute examination by Mr. Beck and Mr. Arnott showed a thin layer of sarcomatous tissue in the wall, so that the case was really one of an enormous effusion of blood into the substance of a small tumour. The man did well, and no recurrence took place.

The true cystic tumours are generally compound—that is to say, they may be either *multilocular*, such as is sometimes found in the ovary or testicle, or

Cystic
tumours.

proliferous, in which some solid substance springs from the interior of the cyst wall, which may entirely fill it up. They occur frequently in the ovary and in the female breast. The proliferating solid portion of the tumour is a vascular tissue which springs from the wall of the cyst, generally at one definite part, but not uncommonly from a great part of the lining membrane, filling it up more or less completely, and ultimately making its way through the cyst and

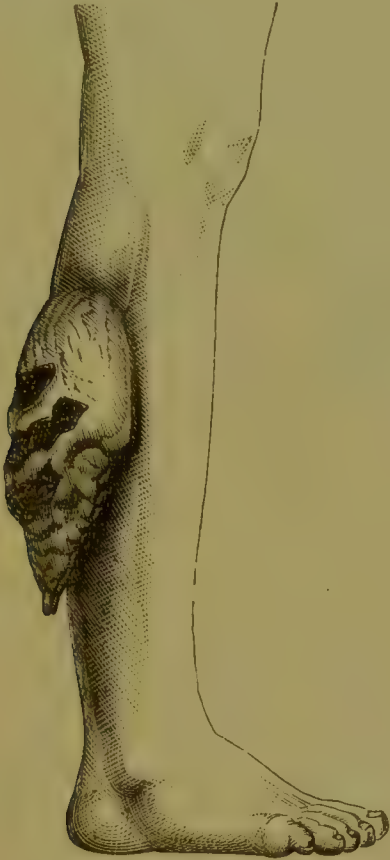


FIG. 159. A blood-cyst situated on the leg. The patient was a healthy man, aged 30. The tumour had been noticed about two years, and had been the seat of repeated and severe hæmorrhage during the last three months. The drawing shows the deep fissures in the tumour from which the hæmorrhage proceeded. It shows also the shape of the tumour, springing from a broad base, pendulous, and overhanging the healthy skin for some distance. The tumour was removed, together with the skin around its base for some distance, in March 1873. The patient made a good recovery, the cicatrisation of the wound being assisted by skin-grafting. He was seen in good health five years afterwards. On examination of the tumour its walls were found to be composed of a thin layer of sarcomatous tissue, the cells from which are represented in Fig. 160.

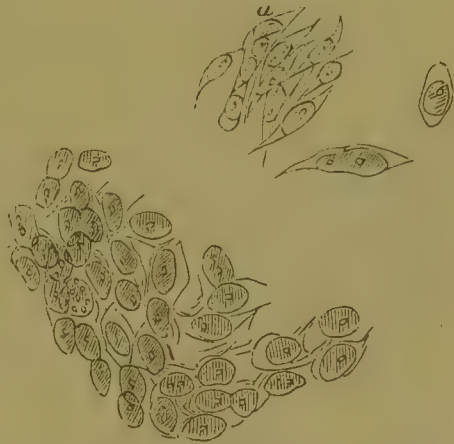


FIG. 160. Cells from the sarcomatous envelope of the blood-cyst shown in fig. 159. The large oval cells shown below formed the bulk of the tumour. Smaller spindle-shaped cells are shown at *a*. The sarcomatous tissue formed a thin layer, not perceptible to the naked eye, in some parts arranged in slight bands shooting up into the papillæ of the skin or spreading beneath them; in others confusedly mixed up with the blood-clot which filled the cyst.—From 'Path. Soc. Trans.' vol. xxiv. pp. 208-214.

then through the skin out of which it fungates. They are far more common in the female breast than in any other part, and the reader is referred to the chapter on Diseases of the Breast as to the diagnosis, pathology, and treatment of these tumours.

Another kind of proliferous cyst is the *cystigerous*, in which the lining membrane of the parent cyst becomes the seat of the formation of a number of secondary cysts. In the ovary such compound cystic tumours are very

common ; and in tumours which before removal appear to be simple cysts secondary cysts will sometimes be discovered. But I do not know that there is much importance in the diagnosis of this from the other form of compound cystic tumour or from the simple cyst.

Congenital
cyst.

III. Among the congenital cystic tumours must be included those tumours which are due to errors of development, amongst which are the meningocele and spina bifida, which will be considered later on. Secondly, an important group of tumours, the *Dermoid cysts*, due to inclusion of a portion of epiblast in a branchial cleft. A very common situation for these dermoid cysts is at the outer upper angle of the orbit, forming a little round tumour slowly increasing in size. Its early removal is necessary, or at least expedient, since the deformity it causes will ultimately render the operation inevitable, when it would require a larger wound and be more difficult ; but the operation is never so easy as it would at first sight appear, since the cyst wall is thin, and it may easily extend very deeply into the orbit, lying constantly in close proximity to the periosteum, and even perforating the bone and lying in contact with the dura mater. The dissection should therefore be conducted very carefully, all possible care being taken not to open the cyst, an accident which will much embarrass the dissection. If this has occurred, it is perhaps best to lay the whole cyst freely open, and, after evacuating its contents, dissect it all carefully from the parts lying below it. Any little fragments of the cyst which have been left behind may prove a source of serious trouble. These cysts usually contain thin fluid and hairs. They are to be recognised from the atheromatous cyst by their being placed more deeply, by their situation in the line of one of the branchial clefts, and by their congenital history.

Occasionally similar dermoid cysts are found in the scrotum, and frequently in the ovary, here their origin is not so easily explained. They were formerly regarded as instances of foetal inclusion—i.e. the elements of which they are composed were regarded as fragments of a blighted twin-fœtus which had been included in the body of the one which grew to maturity. But there is no reason whatever for such a supposition. They contain masses of hair, portions of skin with cutis and cuticle, and frequently one or more teeth, mixed often with a large quantity of fat, and sometimes, besides these truly dermal structures, irregular pieces of well-formed bone are present in them.

Another class of congenital cystic tumours are of uncertain origin ; in some instances they have been supposed to be formed by dilatation of lymphatic vessels. They have received the name of *cystic hygroma*, and occur most commonly in the neck, but are also found in the subcutaneous tissue elsewhere, and especially in the sacral region, constituting one form of congenital sacral tumour. They consist of thin-walled cysts, generally multilocular, containing a clear serous fluid. In the neck they sometimes attain a large size, constituting what is called *hydrocele of the neck*, which sometimes occupies the whole side of the neck and falls like a dewlap over the chest. Such cysts are sometimes translucent, like a common hydrocele.

Amongst cystic tumours may also perhaps be included cysts of parasitic origin, of which the most common is the hydatid cyst ; these will be alluded to in subsequent pages.

Diagnosis
of cystic
tumours.

The diagnosis of cystic tumours rests on several considerations, and will be described in connection with the diseases of the parts in which they occur. Cysts in general are distinguished from solid tumours (a distinction not easy to make when the cyst is very tense and deeply seated) by their elasticity and

perfectly rounded outline; from chronic abscess by the absence of all pain and inflammatory infiltration of the tissues around; and, when any doubt is felt, by an exploratory puncture, which can never do any harm, gives hardly any pain, and will at once settle the question.

Treatment. With regard to the treatment of cystic tumours little can be said here in connection with this brief résumé of so diverse a collection of diseases, but it may be said generally that cystic tumours are better removed entire, than that any attempt should be made to cure them by obliteration by means of a seton, injection of iodine, &c., though of course there must be many exceptions to this general rule.

The connective tissues are those structures which serve the purpose of supporting and connecting the various tissues of the body. They widely differ from each other in external appearance, but possess these features in common, that they are all developed from the same embryonic elements, and have many points of relationship one with another.

Connective
tissue
tumours.

The chief forms of connective tissue are the fibrous connective tissues, including fat; cartilage and bone. And to these must be added a variety of ordinary connective tissue, *mucoid* or *gelatinous* tissue, found in the 'jelly of Wharton' of the umbilical cord and in some other situations in the fœtus, and in the vitreous humour of the eye in the adult, since a definite group of tumours are composed of this material.

The tumours corresponding to these different varieties of connective tissue are as follows:—

Fibrous tissue.	Fibroma.
Fat.	Lipoma.
Cartilage.	Enchondroma.
Bone.	Osteoma.
Mucoid tissue.	Myxoma.

The fibromata are tumours composed of ordinary white fibrous tissue, and as in the healthy body this tissue may be found hard and dense, as in ligaments, or soft, yielding, and flocculent, as in areolar tissue, so these tumours may in the same way be hard, firm, and dense, or soft and loose. Hence it is customary to divide these tumours into the Hard and Soft fibromata, but the structure of the two is essentially the same, and between the typical forms of the two tumours there are numerous gradations as regards their consistency.

Fibromata.

The *hard* fibromata are found principally in the subcutaneous tissue, in connection with the nerves, and growing from periosteum and bone, notably the lower jaw and the base of the skull; but they may be found in many other situations, and in fact in almost any part of the body where fibrous tissue is present. The fibrous tissue of which they are composed is often mixed with other textures, as in the uterus, where an admixture of the unstriped muscular tissue is constant (fibro-muscular). They are also frequently mingled with adipose, glandular, mucous, and other tissues. They form firm and hard tumours, though not so hard as the cartilaginous and bony tumours, and they give a somewhat elastic or springy sensation to the finger when firm pressure is made on them, by which they can generally be diagnosed from these tumours. They are distinctly circumscribed and freely movable, except when connected with bone and periosteum. They are usually round or oval, smooth on the surface, and of uniform consistence. They are generally painless, but to this there is one exception, and that is to a form of fibroma grow-

ing in the subcutaneous tissue, and to which, on account of the great pain which it occasions when handled, the name of 'painful subcutaneous tumour' has been given. The rate of growth of the fibrous tumours is exceedingly slow, and sometimes they may remain stationary for years without any growth at all. They are usually single, but sometimes, especially when connected with nerves, they are multiple. The so-called fibroma of the uterus is also frequently multiple. The true hard fibrous tumours are usually enclosed in a capsule; they have on section a pearly-white glistening structure, and present numerous white bands interlacing in every direction. Examined microscopically they are seen to consist of ordinary white fibrous tissue, being made up of waving bands or bundles of minute transparent fibrillæ, scattered amongst which are a varying number of spindle-shaped or oval cells.

The soft fibromata were formerly described as fibro-cellular tumours, but are now usually regarded as a soft variety of the preceding, to which they are closely allied in histological characters, consisting of waving bands of transparent fibrillæ, but very rarely containing any of the yellow elastic fibres of connective tissue. They are usually found in the subcutaneous connective tissue, where they sometimes form huge pendulous masses or rolls, which are known by the name *molluscum fibrosum*. They constantly occur in the labia of the female (Fig. 161) and the scrotum of the male, and as one form of nasal polypus. In these situations they form smooth, round, soft, often lobulated tumours, which grow painlessly, but much more rapidly than the hard fibromata. They rarely cause much inconvenience, unless, as they frequently do, they attain a considerable size.

The diagnosis of fibromata is not always easy; they may be mistaken when growing in the subcutaneous tissue for sarcomata, but the rate of growth, the regular outline of the tumour, will generally serve to distinguish them from these growths. From bony and cartilaginous tumours, the hard fibromata may be diagnosed by their elasticity and by their yielding slightly on pressure. They are also not as nodular as enchondromatous tumours, with which they are most likely to be mistaken.

The fibromata may undergo many retrogressive changes. They are liable to soften in their centres from mucoid degeneration and to form cysts in their substance. They also occasionally undergo calcification, though this change more commonly occurs in the fibro-muscular tumours of the uterus. In the soft pendulous fibromata ulceration and sloughing sometimes takes place from want of sufficient blood supply.



FIG. 161. A mass of fibro-cellular tumours, removed from the labium pudendi, weighing 7½ lbs. avoirdupois. They were removed by operation, and only one vessel required the ligature. They had given the patient (a widow, aged 40) very little inconvenience during the three years they had been growing, until one burst and discharged a thin sanious fluid. *a* refers to the skin and fat of the labium; *b*, to the pendulous fibro-cellular outgrowths.—(Museum of St. George's Hospital, Ser. xvii. No. 47.)

The only treatment that can be applied to the fibromata is complete removal, and this can generally be most easily and safely accomplished by the knife. In the soft fibromata, when of large size, and especially in cases of molluscum fibrosum, it is better to ligature the base of the tumour subcutaneously (in pieces if need be) before attempting its removal, as the hæmorrhage is often very profuse and difficult to arrest. Or it may be desirable in these cases to remove the growth with the galvano-cautery or écraseur.

The *fatty* are amongst the most common examples of purely innocent tumours. They spring in almost all cases from the natural fat of the subcutaneous membrane, or in connection with deeper-seated fat. In some rare instances fatty tumours have been found in parts naturally destitute of any growth of fat, and fatty tumours have sometimes been found in patients who had died of exhausting diseases, and who had lost the natural fat from all parts of the body. They may grow to any size; and if developed in very early life (which, however, is not common) they sometimes attain enormous proportions, as was the case in a child then aged seven years, from whom Mr. Pollock removed a fatty tumour which, being situated in the middle line of the lumbar region, had been mistaken for a spina bifida, and had therefore been allowed to grow. When removed it weighed 12 lbs.¹ I saw her many years after, in perfect health. Fatty tumour does not often appear at so early an

Fatty
tumours.

age as in this instance. In other respects the case illustrates the common history of fatty tumours: their gradual growth to a large size, without any tendency to suppuration or to degeneration of any kind, or to ulceration of the skin, their size being the only inconvenience; and the complete restoration of the health on their removal. A fatty tumour is often deeply lobulated (as in Fig. 162), but sometimes smooth and globular; in either case it is generally enclosed in a capsule formed by the condensed areolar tissue, and therefore easily separated from the parts around. The skin is generally attached to the



FIG. 162. A large mass of fat under the skin of the scrotum, collected into lobules, and continuous with the fat of the abdomen. The patient died of phthisis, and the rest of his body was much emaciated. The case is described at length by Mr. Gray, in the 'Path. Trans.' vol. vi. p. 230.—(St. George's Hospital Museum, Ser. xiii. No. 14.)

surface of a fatty tumour by numerous strings of areolar tissue; and when the skin is moved on the tumour, dimples are produced in it by the tension of these attachments, a point somewhat characteristic of fatty tumour. The lobulated surface, soft, solid feeling, and slow growth are the other characters of this form of tumour, and are usually sufficient for its diagnosis. Occasionally this, like other forms of tumour, is the seat of neuralgic pain, and this is especially the case in young women, who often have fatty tumours in the shoulder or in the neighbourhood of the breast. In rare cases cysts are

¹ 'Path. Soc. Trans.' vol. viii. p. 360.

found in fatty tumours, and in still rarer instances abscesses may form in them.

Fatty tumours generally form after the period of maturity, but in some rare cases they occur congenitally, as was probably the case in a remarkable instance of fatty tumour, growing in the interior of the spinal canal, which I assisted Mr. Athol Johnstone to remove, and the history of which will be found in the 'Path. Soc. Trans.' vol. viii. pp. 16-28.

Besides the definite and encapsulated collections of fat which deserve the name of tumours there are often met with, especially in very fat, elderly people, enormous ill-defined outgrowths of fat and cellular tissue—such as used to be called 'lipoma.' These have no capsule, but gradually pass into the fat of the part. It may become necessary to remove them on account of the inconvenience they cause; but the operation should not be lightly undertaken. In order to be efficient for its purpose it must involve a very large incision, and the patient is generally not a very good subject for operation.

Fatty tumours are not uncommonly multiple.

The removal of a fatty or any other perfectly innocent tumour is merely a question of convenience. The tumour must be expected to increase slowly; but if the patient is out of health or there is any other special reason for dreading an operation, it may be better to advise him to bear what is after all only a deformity and an inconvenience, rather than incur any real danger. But in most cases the operation involves such trifling risk that it should be at once performed. If the tumour has not been irritated, its attachments will be so loose that if it is lifted in one hand from the subjacent fascia, while with the other hand the surgeon makes a free incision across the whole of the mass, he can turn it out of its capsule with his fingers in a moment, without any dissection. If, on the other hand, the tumour has been irritated or compressed—as, for instance, is often the case in the tumour on the shoulder by the pressure of braces or shoulder-straps—the skin will adhere to it, and it will require formal dissection.

Enchondroma.

Cartilaginous tumours (enchondromata) far more commonly originate from bone than from any other part, and they will accordingly be described further among the Diseases of Bones, where also will be found some illustrations of their most characteristic forms. But they do occur also in the soft parts, frequently in the parotid gland, occasionally in the testicle, and very rarely in the subcutaneous tissue, in the thyroid body and breast, and in other parts. When they originate in bones they are found either as central growths or much more commonly as outgrowths, especially from the bones of the hand and from the neighbourhood of the epiphyses of the long bones. In form they are circumscribed, often deeply lobulated, or apparently composed of distinct bosses united together. They are very hard, but not so hard as bone, and yield slightly on firm pressure, and by this character they can be usually distinguished. They grow slowly, but sometimes attain a very considerable size. They are generally single, but occasionally, and especially when growing from the phalanges, they may be multiple. Cases, however, of multiple enchondromata of the fingers must always be regarded with a certain amount of suspicion, especially when growing rapidly, as they are frequently chondri-fying sarcomata, and therefore of a malignant character.

They are purely innocent tumours, and if once removed entire will never recur. Sir J. Paget has, however, recorded¹ a single instance in which a cartilaginous growth originating in the testicle and presenting every character

¹ 'Med.-Chir. Trans.' vol. xxxviii. p. 247.

of an ordinary enchondroma passed up the lymphatic vessels, pressed upon and perforated the vena cava inferior, and was thus conveyed into the lungs, where it attained so large a size as to prove fatal. This case is a very striking and instructive one; it does not, however, show—nor does Sir J. Paget record it as showing—that enchondroma is ever, when occurring unmixed, a malignant disease, but as proving that the elements of any growing tissue, if they pass into the blood, may become multiplied there to an indefinite extent. Formerly a class of tumours was described as ‘malignant enchondromata,’ and it was believed that a certain class of cartilaginous tumours were of a malignant character; it is now known that these cases are instances of sarcomatous tumours which have undergone chondrification. They will be described more fully with the sarcomata.

To the naked eye enchondromata present all the appearance of ordinary cartilage, or sometimes fibro-cartilage, and microscopically they are found to consist of simple hyaline cartilage consisting of stellate cells embedded in a hyaline matrix. They are enclosed in a fibrous envelope, and frequently have a bursa developed between them and the skin beneath which they lie. Sometimes they appear to be made up of a number of bosses or masses, each surrounded by its own fibrous envelope, and it is this which gives the appearance of extreme lobulation to some of these cases.

Enchondromatous tumours may undergo various secondary changes. When growing from the neighbourhood of the epiphyses of one of the long bones they are very prone to ossify. In fact, these tumours nearly always become rapidly converted into bone, covered over only by a thin layer of ossifying cartilage, and are usually described as one variety of osteomata. They may also degenerate in various ways. Some break down in their centre, so as to form large cysts, which become filled with a fluid resembling synovia (cystic enchondromata); others soften throughout; others become converted into a calcareous mass, in which it is difficult to discover any definite organisation.

The free removal of an enchondroma is all that is necessary for the patient's future safety. Amputation may be indicated if the size and connections of the tumour demand it, and in cases of multiple enchondromata on the fingers or toes it may be the only resource available; but such cases will be discussed hereafter.

Bony tumours are not absolutely unknown in the soft parts. There are some rare cases in which the muscles ossify, as in a skeleton preserved in the Museum of the Royal College of Surgeons, in which many of the bones are connected immovably by masses of bone which have replaced some of the largest muscles in the body; and other singular cases occur, like that recorded by Mr. Cæsar Hawkins,¹ in which masses of bone were formed loose in the cellular tissue of the muscles. But such cases are so very uncommon and have so little bearing on practice that exostosis may be regarded as a disease of the bones, and will accordingly be treated of in that chapter.

The myxomatous tumours are growths of the connective tissue type, the essential feature of which is the presence of a gelatinous material resembling the Whartonian jelly of the umbilical cord. The number of tumours found

¹ ‘Contributions to Pathology and Surgery,’ vol. ii. p. 193. Mr. Hawkins describes the formations of bone in the case which he relates as the result of ossification of the muscular fibres in consequence of inflammation, and refers to some similar instances; though, as he observes, ‘we cannot say why the muscles inflame, nor why the common results of inflammation are modified so that bone is formed in the cellular tissue of the muscles.’

in this group is not large, and there can be no doubt that many of the cases which are classified as myxomatous tumours are in reality degenerated forms of other growths—that is to say, other tumours, such as the enchondromata, fibromata, or adenomata, which have undergone mucoid softening.

They usually grow from the subcutaneous and submucous tissues, and when superficial often assume a polypoid form, as in the ordinary gelatinous polypus of the nose. They form soft, lobulated, round or oval masses, which frequently it is impossible to distinguish from the lipomata or soft fibromata. They are usually of slow growth, and are met with for the most part in adult life.

They are enclosed in a loose fibro-cellular capsule, and on section present a gelatinous appearance, of a pinkish colour, much resembling a colloid growth, from which, however, they may be distinguished by the fact that this latter growth is contained in cysts and by their microscopical characters. Under the microscope they are found to consist of a beautiful open network of fine fibres, which are the processes of large stellate cells, freely communicating with one another (Fig. 163). In the interstices of this network is a jelly-like substance, which contains mucin, which is almost fluid, and when the tumour is cut into oozes slowly away. Embedded in the jelly may be found numerous small round cells, having no apparent connection with the stellate cells.

The true myxoma is an innocent tumour, but occasionally sarcomatous tumours undergo mucoid degeneration, forming the myxo-sarcomata, and these tumours are malignant in their characters.

The only treatment is removal, and, as a rule, this can be generally done without difficulty and with a confident reliance that the growth will not return. Occasionally, however, myxomata are found in connection with nerves, and then great care must be exercised in their removal, as the nerve becomes embedded in the morbid growth and is liable to be injured.



FIG. 163. Section of Myxoma. *a.* Angular or stellate bodies the prolongations of which anastomose so as to form a network traversing the whole section. *b.* Small round cells, having no apparent connection with the angular corpuscles. *c.* Corpuscles having much resemblance to mucous corpuscles, but smaller, contained in the prolongations of the branching or angular bodies. These prolongations have double outlines, and appear to form canals, in which the mucous corpuscles are contained. Some fatty tissue was mingled with the structure of this tumour. —(From 'Path. Trans.' vol. xx. p. 344.)

Tumours
composed
of complex
tissues.

In the second group of solid tumours we place those growths which resemble in structure more or less completely one of the more complex tissues of the body—such growths, in fact, as resemble muscles, vessels, nerves, glands, &c. The group will comprise the following:—

- Vascular tissue: Angeioma.
- Lymphatic tissue: Lymphoma.
- Muscular tissue: Myoma.
- Nervous tissue: Neuroma.
- Papillary tissue: Papilloma.
- Secreting glandular tissue: Adenoma.

The angioma, vascular, or erectile tumours are composed of enlarged vessels, these vessels being either arterial, capillary, or venous. The tumours which are formed chiefly of enlarged arteries are called aneurisms by anastomosis. They are large, irregular, lobulated, pulsating masses, in which a considerable bruit can often be heard, and numerous large vessels can be traced into them on all sides. The capillaries share in the enlargement, and the veins thus receive the pulsation. As the arteries enlarge their coats become thinned, so that the distinction between the arteries and veins around the tumour becomes impossible. The growth of the tumour sometimes causes ulceration of the skin, and severe or even fatal hæmorrhage; but apart from this there is not much danger, and I have seen cases which have gone on for an unlimited time without material change. Sometimes, however, when the disease occurs, as it usually does, on the head, the constant noise is so distressing, and the increase of the tumour so threatening, that the surgeon is compelled to interfere.

The diagnosis is usually obvious. At the same time I have seen a pulsating cancer of the skull mistaken for aneurism by anastomosis and operated on, the patient being with difficulty saved from death on the table. A more

accurate examination would have shown in this case that the skull was perforated, for pressure on the tumour produced vertigo, loss of consciousness, and partial hemiplegia.

The favourite seats of this disease are the scalp and the lip. In the scalp they are commonly close to the ear, and the disease often extends into and implicates the vessels of the ear.

They have been treated by all kinds of operations. When small they might possibly be

FIG. 164. Aneurism by anastomosis of the upper lip. From a drawing presented by Sir B. Brodie to the Museum of St. George's Hospital.

cured by setons or by ligature applied as to an ordinary nævus. The large tumours are best treated by the galvanic cautery. The wire being passed through the mass at its base is then attached to the battery, so as to bring it to a white heat, and is drawn slowly out to the surface, cutting the tumour into two parts and searing the divided surface as it cuts, so that no hæmorrhage occurs. This may be repeated in several places, and so the tumour will be divided by several cicatrices, by which the vascular tissue will be obliterated. As fresh parts threaten to grow they must be treated in the same way. Bleeding may occur during the separation of the sloughs, and must be combated either by the ligature or actual cautery.

The total removal of the tumour is a still more certain method of treatment, but the operation is highly dangerous when the growth is large. An incision is made around a part of the base of the tumour, cutting across several large



vessels, which are then tied. If the patient has not lost too much blood the cut is then extended around another part or the whole of the circumference, and again the divided vessels are tied. When the whole circumference has thus been dealt with, the mass is rapidly removed and all vessels at its base secured. In large tumours it is often necessary to divide this operation into several stages, allowing an interval between each for the recovery of the patient from the results of hæmorrhage. The ligature of the main trunk artery (the common or external carotid) has often been practised in aneurism by anastomosis; even the common carotids on both sides have been tied, with a due interval. But I cannot discover that the practice has been so successful as to justify the operation. Mr. Southam has published a successful case,¹ but here the seton was also employed. On the other hand, I remember a remarkable case in which the patient had been in great danger from repeated hæmorrhage. This had been suppressed and the patient restored to health and comfort by the persevering use of the galvanic cautery. Three years afterwards the bleeding recurred, and a surgeon was sent for, who, unluckily for the patient, tied the common carotid. The man bled to death fifteen days afterwards, while the ligature was still firm on the vessel.² At the same time cures are claimed after this operation, the reality of which I am not concerned to dispute. All that I would say is, that I believe local cautery to be safer and more efficient.

Nævus.

Capillary and venous tumours are called *nævi*,³ and *nævi* are also divided into cutaneous and subcutaneous, the purely venous *nævi* being usually subcutaneous, those entirely confined to the skin being always capillary only; while those in which the skin and cellular tissue are affected simultaneously are usually of the mixed kind; and in all such cases large veins will be seen running away from the tumour.

The obvious difference in surgical anatomy between *nævus* and other congenital tumours consists in the large size and great number of the vessels in *nævus*. But there are many intermediate stages between the simple congenital fibrous or fibrocellular tumour, such as we sometimes see on the skin or mucous surface of the mouth, the fibrocystic tumour sometimes containing a large quantity of blood in its cystic spaces (a tumour which often occurs congenitally in the neck), and the true *nævus*, in which the blood is contained in enlarged vessels, rather than vascular spaces, the number and size of which masks the fibrous framework which supports them. Such congenital tumours are undoubtedly of the same nature as *nævus*, and *nævi* often degenerate into masses almost exactly similar to some of these forms. Hence some pathologists regard *nævi* as congenital fibrous tumours, in which the different arrangement of the fibrous stroma has necessitated a corresponding enlargement of the vascular channels.

The nature of the common *nævus*, or mother-mark, is obvious at first sight, and in some more serious cases the whole or great part of the side of the face is implicated in a similar dilatation of the capillaries, called 'port wine stain,' or along with the enlarged vessels there is a pigmentary formation, and often an overgrowth of hair. Mr. Marrant Baker has published an instance of the successful extirpation of one of these hairy moles ('*Med-Chir. Trans.*' vol. lxi.). The ordinary capillary *nævus* is very common indeed; and as a great many (I think the majority) of such *nævi* remain without any growth

¹ '*Med.-Chir. Trans.*' vol. xlviii. p. 65.

² '*Lancet*,' 1858, vol. ii. pp. 75, 339.

³ Some authors also speak of aneurism by anastomosis under the name of '*arterial nævus*.'

indefinitely, they should be left alone, unless from their situation they occasion any unpleasant deformity, or from their growth it becomes necessary to treat them, in which case, if they are in a position where a scar is of no consequence, they should be removed either by ligature or with the knife. The latter is safe enough if the tumour be avoided, but as the former is quite free from all risk of hæmorrhage it is more commonly used, especially in private practice. Two stout harelip needles being passed beneath the nævus at right angles, a strong ligature is tied beneath them as tightly as possible. If the mass is large it is well to cut a groove in the skin from each needle to the one next it for the ligature to lie in. The great point is to tie the ligature tight enough, in which case there is no pain afterwards. The surgeon may be

Ligature
of nævus.



FIG. 165. Drawing, the size of nature, from a nævus which was dissected out of the back and front of the hand. It lapped round the second metacarpal bone and presented in the palm of the hand, but was situated chiefly on the dorsum. Esmarch's bandage was applied, and the dissection was easily accomplished without wounding any important structures. The use of the hand was, I believe, perfect afterwards. *a*, refers to a small piece of skin which, as it was thin and very closely adherent to the tumour, I thought it best to remove along with it. The patient was a boy æt. 11.—(From a preparation in the Museum of St. George's Hospital, Ser. vi. 98f.)

certain that the tumour is completely strangulated if he pricks it with a needle here and there while the ligature is drawn tight, and sees that at last only a little serous fluid oozes from the punctures. The points of the needles should be cut off with pliers made for the purpose, and a strip of lint wound under them and round their ends. When the mass has turned black the needles may be removed and a poultice applied till the slough drops off. The subcutaneous nævi may be removed like any other subcutaneous tumour, by dissecting the skin from above them and removing them without opening the capsule in which they are contained;¹ or if at any stage of the operation the surgeon should meet with alarming hæmorrhage the ligature may be substituted. And in nævi which are only partly subcutaneous a similar operation may be performed, i.e. the skin may be dissected from the mass below, generally without much hæmorrhage, and the latter be thus removed. But I cannot say that in the few trials I have made of this method I have seen much use in the

Enuclea-
tion.

skin so preserved. It is, in fact, so thin and ill-nourished that it generally sloughs or withers away.

The caustic treatment of small nævi is very satisfactory. The caustic generally used is nitric acid, or the acid nitrate of mercury, which will remove a small mother-mark in two or three applications, leaving, however, a small depressed cicatrix very like that of vaccination. The actual cautery by means of a whitehot needle, or a point of whitehot metal with a bulb above, by which the heat is prevented from too suddenly being quenched, is also often used, and successfully. But many of these small nævi may be removed with less deformity by the application of the electrolytic current:

Caustics.

Electro-
lysis.

¹ See Teale, in 'Med.-Chir. Trans.' vol. i. p. 57. Parker, 'Clin. Soc. Trans.' vol. xix. p. 279. The existence of a complete capsule subdividing the growth into lobules is very distinctly described in the account which Mr. Birkett has given of the structure of a nævus in the 'Med.-Chir. Trans.' vol. xxx. p. 193.

i.e. a current of electricity of very low power continued for some time, so as to disintegrate the tissues without cauterising them.

The electricity in these cases is best supplied from a Stohrer's battery in which one needle is plunged into the nævus while the other may either be applied to the skin, or be also driven through the tumour, but so as not to be in contact with the former. As the disintegration progresses, the position of these needles is to be frequently changed and reversed. No sloughs should be produced.

Vaccina-
tion.

Another plan which should be mentioned is vaccination. If the child has not been previously vaccinated he may be vaccinated on the nævus, the vaccine being introduced in a great many places very close together. The object is to obliterate the vascular tissue by the inflammation produced around the vaccine pustules. But the plan is not one which deserves recommendation. It is very uncertain, since the vaccine may be washed away by the blood, and it has usually, if not always, failed in the cases which I have seen; and when vaccine pustules are produced it by no means follows that the nævus is cured, or that the child has obtained the proper immunity from small-pox.

Coagula-
ting injec-
tion.

Again, subcutaneous nævus, especially those large nævi which sometimes occur in the parotid region, may be treated by the injection of perchloride of iron. The method, however, is a dangerous one, one case, at least, being on record in which instant death was caused, probably by coagula carried into the heart.¹ If it is employed the solution should be used in small quantity, three or four drops being injected through the hypodermic syringe first in one place and then in another, and the situation of the tumour should be surrounded if possible by an elastic ring or temporary ligature. Some surgeons first break down the tissue of the nævus with a broad cutting needle, and then introduce the coagulating injection into the cavity so produced.

Subcuta-
neous liga-
ture.

The larger nævi require complicated forms of ligature for their strangulation. Those that are entirely subcutaneous are generally treated by the subcutaneous ligature. The needle (which should be a large one) is armed with a strong piece of whipcord. This is entered at one point of the circumference, and carried round the base as far as possible, when it emerges through the skin. The ligature having been drawn through as far as necessary is re-entered at the same puncture and carried round another portion of the circle, and so on, till at length it reaches the original point of entry, through which its two ends now protrude and must be tied as tightly as possible (Fig. 166). Or if the mass is too large to be dealt with in this way the ligature may first be carried under the middle of the tumour, and

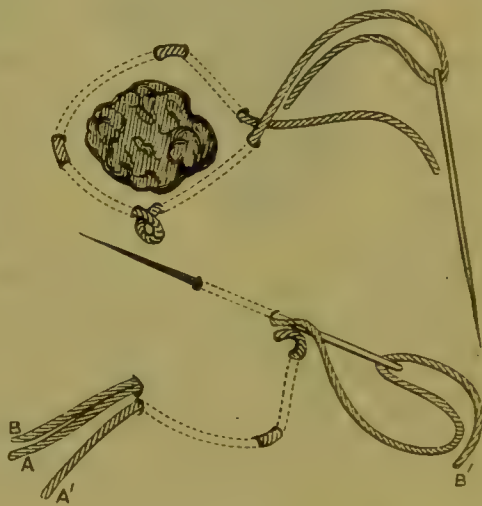
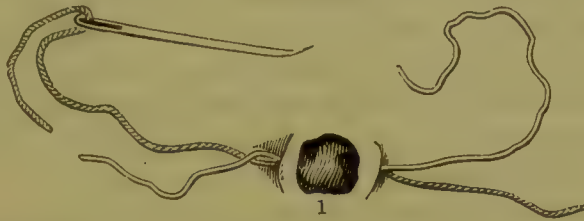


FIG. 166. Subcutaneous ligature of nævus. The upper figure shows a single ligature carried round the tumour. The lower (in which no tumour is depicted) shows a double string carried below the centre of the base, then divided into two, A A' and B B', and each of the two carried subcutaneously round half of the nævus, and then tied.

¹ Teale, 'Med.-Chir. Trans.' vol. i. p. 62.

may then be divided into two, each of which is applied as before subcutaneously to each half. Another excellent knot for a large nævus is that which goes by Sir W. Fergusson's name, and which is represented in Fig. 167.

1. The threaded needle passed under the centre of the base of the tumour; one thread divided near the needle.



2. The other end of the divided thread passed into the needle's eye. Both threads carried round a quarter of the circumference and passed under the base at right angles to their former direction.



3. The needle withdrawn and the nævus strangulated in quarters.

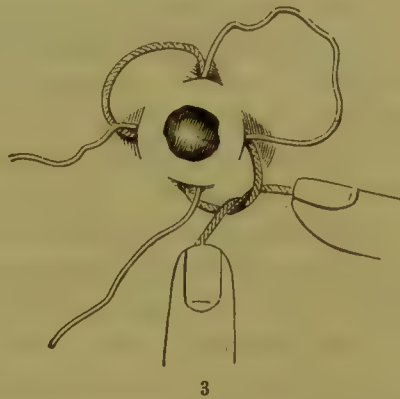


FIG. 167. 'Fergusson's knot,' for the strangulation of large nævi, or other tumours. In order to keep the diagrams of a convenient size the tumour has been represented relatively much smaller than it is in practice; and in Fig. 3 the incisions, which are usually made through the skin from each puncture to the next, have been omitted, to avoid complication. They are not absolutely necessary, if the mass is not very large, but they reduce the quantity of tissue which is to be cut through by the ligature, and promote the success of the operation, besides very probably saving the patient some pain while the ligature is separating.

In other cases, where the tumour is of an elongated form, the form of ligature represented in Fig. 168 is more appropriate. The tumour is strangulated in pieces by passing a double ligature under its base from side to side, as there shown. The ends of the ligature are coloured differently—say one white and the other black. Each loop is left long, so that the whole ligature must be of great length. Then the white loops are divided on one side and the black on the other, and the pairs of white and black strings are tied tightly. The whole tumour will thus be found to be strangulated.

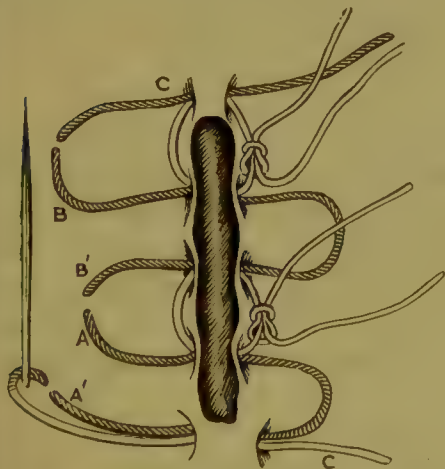


FIG. 168. Ligature for strangulating a large nævus. The white loops are divided on one side, and the black on the other, and the corresponding ends (as A A', B B') tied together. The terminal strings C C may be either tied or withdrawn, as the surgeon thinks best.

The two latter methods necessarily involve the death of the skin, and even although the purely subcutaneous ligature does not, perhaps, involve the death of the skin by absolute necessity, since enough nutrition may be provided by

the vessels which pass into the skin between the punctures to avert gangrene, yet such a fortunate result is not often obtained. More commonly the sub-

cutaneous ligature sets up extensive inflammation, in which the whole tissue perishes, including the skin.

Mr. Barwell has described a process for the 'scarless eradication' of nævus¹ by means of an instrument whereby a wire conveyed subcutaneously around the base of the tumour is gradually tightened by means of an appropriate mechanism until it comes away, and so divides all the vessels which nourish the subcutaneous part of the nævus. After this the cutaneous nævus can be treated with nitric acid if necessary, but often withers away and disappears spontaneously.

Another plan which will often check the growth of large nævi, and which is eminently useful in situations where their complete removal is impossible or very dangerous, is to cut them into pieces by ligatures conveyed under their base and tied tightly round the entire tissue. If the growth be so large that the first ligature will not ulcerate through it, a second can be introduced into the groove which the ulceration of the first has caused, and thus when the ligatures have come away the tumour will be divided into portions by wounds, in which bands of cicatrix will form, and so its growth will be arrested. A case of venous nævus in the scrotum treated successfully in this way will be found described and figured in the 'Path. Soc. Trans.' vol. xv. p. 95.

There are other methods of treating nævi too numerous to mention. I need only add that very large nævi are often cured by the introduction of setons. Some surgeons steep the seton-threads in perchloride of iron.

Degeneration of nævi.

Nævi which do not grow may remain stationary, or may disappear, or may degenerate. In some cases, usually after an attack of some grave illness, such as scarlet fever or whooping-cough, even large nævi have been known to disappear altogether. Thus in the discussion on Mr. Teale's proposal for enucleating the large nævi which sometimes form in the parotid region, Sir Prescott Hewett related an instance in his own family where a nævus of this kind had entirely disappeared soon after one of the common affections of childhood. In other cases the tumour after ceasing to grow degenerates into a cystic mass, and this is a probable cause of one form of congenital cystic tumour. The contents of the tumour may vary very much from the composition of the blood, though they generally show some trace of their origin.

Lymphoma.

The lymphomatous tumours are growths exactly resembling in microscopical structure adenoid or lymphoid tissue. They grow from this tissue, and it is doubtful whether they are simple, non-inflammatory hypertrophies or true neoplasms. In fact, the whole pathology of these growths is in a very uncertain condition, as is evidenced by the confused nomenclature with which they have been burdened. The simplest plan of describing these growths will be to consider them under two heads, as the simple lymphoma and the malignant lymphoma.

Simple lymphoma.

In simple lymphoma, a single gland generally, but sometimes two or three, slowly and progressively enlarges. This enlargement is not inflammatory, for there is no pain nor tenderness, nor indeed any sign of inflammation. It does not become adherent to the skin, nor matted to the surrounding parts, and has much the same consistence as the normal gland. It is not tubercular, and is not associated with any constitutional defect. It is

¹ 'Lancet,' May 8, 1875.

simply a local enlargement, steadily increasing up to the size possibly of a hen's egg, and then very often remaining stationary. It does not return if removed. It is usually found in the neck, and forms a smooth, rounded, or oval, freely movable, elastic tumour. Upon removal, it is seen to consist apparently of ordinary normal lymphoid tissue, and has precisely the structure of a lymphatic follicle.

Malignant
lymphoma.

The disease known as malignant lymphoma is a peculiar hypertrophic disease of the lymphatic glands, commonly spoken of as 'Lymphadenoma,' which was first distinctly described by Dr. Hodgkin,¹ and often called after his name 'Hodgkin's disease.' The disease begins as an enlargement of certain glands, without apparent cause. The enlargement affects usually first the cervical glands, then spreads to those in the axilla, and sometimes to glands in many parts of the body. But the disease does not necessarily appear first in the glands of the neck; it may, and often does, commence primarily in the axillary or other glands. The cause of the disease is entirely unknown. It usually occurs in early adult life, and is entirely unconnected with any tubercular or syphilitic dyscrasia.

The disease, commencing generally in one gland, as a non-inflammatory enlargement, spreads with greater or less rapidity from gland to gland until a whole group or chain of glands becomes affected. Then other chains of glands in other parts of the body become similarly affected. Thus tumours made up of large smooth bossy masses make their appearance in those parts of the body where superficial lymphatic glands are known to exist. They do not contract adhesions, show no tendency to break down, and remain well encapsuled. The same disease affects the lymphatic vessels in many parts of the body, forming tumours in the spleen, lungs, liver, and other organs, which are believed to depend on deposit of adenoid tissue in the cellular membrane enveloping the lymphatic vessels. The disease is also described as affecting the medulla of bone by Mr. Macnamara,² and the testicle by Monod and Terbillon.³

In some cases it is associated with the condition known as 'leucocythæmia,' in which the elaboration of the blood is imperfect, so that the white cells are disproportionately increased. It is then sometimes termed 'leucœmic lymphadenoma,' and the spleen is early implicated in the disease in these cases. But there are many cases in which the spleen is involved, and in which no such condition of the blood exists.

Accompanying these local conditions there is marked deterioration in the patient's general health. He becomes rapidly emaciated and anæmic, loses his appetite and strength. Profuse diarrhœa, and often dropsy, supervene, and the patient generally dies from exhaustion in from one to two years from the onset of the disease.

The growth, upon examination after removal, presents precisely the characters of a normal lymph follicle. It is usually described as of two kinds, to which the terms *hard* and *soft* have been applied, but the difference in the consistence appears to be simply due to the relative amount of fibrous tissue and cells, the former preponderating in the hard form, the latter in the soft.

As regards treatment, operative measures appear to be of no avail. My colleague, Mr. Haward, at one time advocated the removal of the glands where it was possible to remove all of those affected by the disease, and in several cases performed this operation; but I believe the results were not

¹ 'Med.-Chir. Trans.' vol. xvii.

² 'Diseases of Bones and Joints.'

³ 'Arch. Gen.' July 1879.

sufficiently satisfactory to induce him to persevere with it.¹ But at the same time, considering the fatal nature of the disease with which we have to deal, it would seem desirable, if the whole of the mass can be extirpated, and there is no discoverable enlargement of the glands of any other part of the body, to make the attempt. In order, however, to render the chances of the operation favourable, the diagnosis must be made early, and herein is the difficulty, for when these tumours first appear it is impossible to recognise their true nature and to make a precise diagnosis. There can be no doubt that arsenic has a very considerable effect in many cases of lymphadenoma, though in others it appears to exert little or no influence. In order to produce any benefit it must be pushed until it produces slight toxic effects. The administration should be commenced with the ordinary dose of the drug, say five minims of the liquor three times a day, and gradually increased until slight symptoms of arsenical poisoning are produced. The dose is then to be maintained at this point for some considerable time, and under the influence of the medicine the glands will often rapidly diminish in size. It is advisable, whilst the patient is taking the arsenic, to give a mercurial purge occasionally to correct the toxic effects of the drug. In some cases, where arsenic has apparently succeeded in arresting the disease and materially diminished the size of the glands or caused them entirely to subside, a fresh appearance of the disease occurs after the medicine has been left off, and the case proceeds to a fatal termination.

In simple lymphoma, where one, or at the most two or three glands are enlarged, they may be removed without any fear of a recurrence taking place.

Myoma.

True myomatous tumours, that is to say, tumours consisting simply of muscular tissue, are exceedingly rare. A few instances have been recorded of these tumours, consisting of striped muscular fibres, as a congenital affection, and for the most part have been found in the neighbourhood of the kidney, and a few cases of muscular tumour, where the fibres were of the unstriped variety, have been recorded as occurring in connection with the alimentary canal and particularly the œsophagus. But there is a large and common class of tumour in which muscular tissue forms an important component of the growth, but in which it is associated with some other structure. These tumours include the large class of so-called 'fibroids' of the uterus, which are really myo-fibromata, and consist of smooth muscular fibre, intermingled with fibrous tissue, and also 'enlarged prostate,' in which the disease is a myo-adenoma, consisting of smooth muscle fibres, with irregular glandular hypertrophy. These will be described in the chapters on Diseases of the Generative Organs. As regards the diagnosis of true myomata nothing can be said. It is impossible, except by microscopic examination, to distinguish them from fibromata, and occurring as they do in connection with the internal organs they do not, as a rule, come under the cognisance of the surgeon.

Neuroma.

Formerly any tumour connected with or growing on a nerve was termed a 'neuroma.' These are now classified according to their structure as fibromata, myxomata, sarcomata, &c., and may be styled 'false neuroma'; whilst the term 'neuroma' is confined to those tumours which are actually composed of nerve fibres, and these are exceedingly rare. Lebert and some other observers have, however, asserted that the bulbous condition which a divided nerve assumes, as after amputation, ought to be regarded as a true neuroma, since it

¹ See 'Clin. Soc. Trans.' vol. ix. p. 40.

contains nerve-tubules. These are, however, very much smaller than normal nerve fibres, and are probably merely the old fibres atrophied by the pressure of the fibrous tissue which has been developed from the inflammatory exudation in the end of the divided nerve.

True neuromata are always found in connection with nerves, and are almost invariably made up of medullated nerve fibres rolled up and interlacing and connected together by ordinary connective tissue. Some few rare instances of neuromata composed of non-medullated nerve fibre have been described. They may occur without any injury to the nerve and are frequently multiple. They vary in size and are generally round or oval and smooth on the surface. They are connected with some nerve trunk and generally on the extremities, and therefore lateral movement of the tumour is always much more free than any longitudinal movement in the direction of the axis of the nerve on which they are placed. The amount of pain is very variable ; sometimes it is very acute, at other times there may be none. They are generally tender on pressure, and sometimes the most acute pain is experienced on pressing the tumour not only in the part itself, but also in the peripheral terminations of the implicated nerves.

These tumours should not be interfered with unless they cause pain, and then they must be excised. Frequently this can be done without division of the nerve trunk. The limb having been rendered bloodless, the tumour can be enucleated by a careful dissection. Should it be necessary to divide the nerve in order to excise the tumour, the ends must be at once sutured together.

Papilloma or warty tumour is a term applied to tumours resembling in structure the ordinary papillæ of the skin or mucous membrane. They are, in fact, simple hypertrophies of these structures. Like the papillæ, they consist of loops of blood-vessels, supported by connective tissue and covered by epithelium, but instead of being merely of microscopic size they attain sometimes very considerable dimensions, and indeed occasionally form tumours of large size. The blood-vessel of a papilloma, instead of forming a minute loop, as in an ordinary papilloma, is often a vessel of considerable magnitude, which divides and subdivides into numerous branches, each terminating in a loop covered by epithelium, and the whole of the branches supported and surrounded by connective tissue, so that we have a branched growth, not unlike a cauliflower, made up of a number of compound papillæ ; or occasionally the vessels may become enormously elongated, and we have then a villous growth, not unlike the villi of the chorion. This growth is sometimes connected by a narrow stalk or pedicle with the structure from which it springs. The vessels of papillomata are frequently much dilated, rendering the growth very vascular, and liable to bleed furiously if these vessels are opened up by ulceration or injury. The connective tissue which holds together the vessels is sometimes very abundant, sometimes scanty, and in tumours of rapid growth is crowded with round cells. It contains lymphatic spaces. Papillomata may grow either from cutaneous or mucous surfaces, and the epithelium covering them corresponds to that of the structure from which they grow. Thus when growing from the skin they are covered with flattened scales resembling the epidermis, when growing from the mucous membrane of the rectum they are covered with columnar epithelium similar to that found in this situation. The amount of epithelium varies : sometimes, as in the common wart, they are covered with many layers of horny epithelium, and they are then hard ; in other situations, as in the papillomata of the rectum, they are covered with a

Papil-
loma.

single layer of columnar epithelium, and they are then soft. When they are covered by many layers of epithelium, the deeper ones may be pigmented, so as to give a dark or even black appearance to the tumour.

Papillomata, when growing from the cutaneous surfaces, are often due to some form of irritation. Thus they are frequently found on the hands of children and domestic servants from want of cleanliness; on the vulva of women from the irritation of the discharge of gonorrhœa; around the corona glandis of men, especially those who suffer from phimosis, from the irritation produced by the accumulation of the secretion of the *glandulæ odoriferæ*.

The principal forms of papillomata found on the skin are corns, warts, and condylomata. On mucous surfaces papillomata occur most frequently on the tongue, in the larynx, in the rectum, forming the so-called polypi of the rectum, and in the bladder as villous growth.

Papillomata are purely innocent tumours, but they are liable to ulcerate and bleed freely, and may cause death from hæmorrhage. They may become the seat of some secondary malignant growth; for instance, a wart not unfrequently may merge into an epithelioma. The tumours then ulcerate and the base becomes hard and infiltrated. Papillomata of the skin, warts, &c., will sometimes disappear when the irritation which has given rise to them is removed. Not unfrequently we see this in children whose hands may be covered with warts, and who, when they arrive at an age which induces them to pay more attention to the cleanliness of these members, entirely lose these growths without any treatment whatever.

The treatment of the various forms of papillomata will be considered in connection with the surgery of the different regions of the body in which they are found.

Adenoma.

The adenomata or glandular tumours are those growths which in their minute structure resemble ordinary secreting gland tissue. Secreting glands present two distinct varieties, according as they are saccular or tubular, and in accordance with this we find two classes of adenomata, the racemose and the tubular. The former are always found in connection with the racemose glands, as the breast, the prostate, or the salivary glands. They are composed of small sacs or spaces, irregular in shape and corresponding to the acini of secreting gland tissue, lined by short columnar or spheroidal epithelium. These sacs communicate with each other and are bound together, in the true adenomata, by fibrous tissue. Occasionally, instead of ordinary connective tissue forming the matrix by which the sacs or spaces are limited, there is a tissue resembling spindle-celled sarcoma, consisting almost entirely of spindle-shaped cells; this constitutes a special group of tumours which are known as the *adeno-sarcomata*. Again, in other cases the connecting material presents more of the character of myxomatous connective tissue, and these tumours would be classed as the adeno-myxoma.

The true adenomata have frequently cysts developed in them; this is due to dilatation of one or more of the sacs or acini and accumulation of fluid in their interior.

The racemose adenomata form round or ovoid nodular tumours, for the most part solid and hard, but occasionally soft in places from the development of cysts. They are clearly defined and freely movable on the parts around and, when superficial, beneath the skin. In the mammary glands, which is by far the most common situation in which they are found, they occur in young unmarried women. They are here freely movable and separable from the tissue of the breast, though at the same time apparently

connected with it by a sort of pedicle or stalk. They grow slowly, produce no retraction of the nipple or enlargement of the axillary glands. Sometimes they are painless, at other times associated with severe neuralgic pain, and oftentimes a sensation of fulness and enlargement is complained of at each menstrual period. In the parotid they are generally associated with enchondroma and myxoma, and constitute the ordinary 'parotid' tumours. In the prostate they produce chronic enlargement in association with increased growth of the muscular tissue, forming the class of tissues already alluded to as the myo-adenomata.

The tubular adenomata consist of tubules, resembling the crypts of Lieberkühn, lined by columnar epithelium, and bound together by connective tissue. They are principally found in the intestinal canal, especially the rectum, where they form one variety of polypoid tumour, and occur most frequently in children and young persons.

The adenomata, when unassociated with any other form of tumour, are non-malignant, and if causing any pain or disfigurement may be removed without any fear of a recurrence.

Amongst the tumours composed of a tissue analogous to embryonic tissue, there is only one large and most important group of tumours, known as the 'sarcomata.' It is only recently that these tumours, which formerly were known by other names and classed in other groups, have been definitely arranged in a distinct class by themselves. They have been defined by Billroth as tumours 'consisting of tissue which belongs to the developmental series of connective tissues, and which does not, as a rule, go on to the formation of a finished type of tissue, but tends rather to peculiar degenerations of the developmental forms.' They are composed of embryonic connective-tissue cells, embedded in an intercellular substance, which may be either scanty or abundant, homogeneous or fibrous—that is to say, they may or may not have any definite stroma. If they have, it is not arranged in the form of alveoli, with perhaps one doubtful exception, but penetrates between the individual cells; and herein lies one important anatomical distinction between the sarcomata and the carcinomata, in which the stroma is always arranged in the form of alveoli. These growths are exceedingly vascular, permeated by large vessels with very thin coats, which easily rupture; or even, as is believed by some, by channels bounded by the growth itself, and without any true walls. No lymphatics have ever been demonstrated in these tumours, and it is usual for them, when they infect the system, to do so through the blood-vessels, and not like the carcinomata, through the lymphatics. To this general rule there are, however, exceptions, especially in the melanotic sarcomata.

Tumours composed of embryonic tissue. Sarcoma.

The sarcomata are divided, according to the shape of the cells of which they principally consist, into four main groups: (I.) the round-celled; (II.) the spindle-celled; (III.) the mixed-celled; (IV.) the myeloid or giant-celled.

I. The round-celled or granulation sarcoma (Fig. 169) is composed of small round cells, like leucocytes, such as are found in granulation tissue, the intercellular substance being either distinctly fibrous, or fibrillated, or perfectly homogeneous. They are soft, pulpy, whitish or grey, and were formerly regarded as encephaloid cancer. They grow with great rapidity and are very vascular, the vessels often giving way from the great tenuity of their coats and extravasations taking place into their substance. They grow principally from the skin and subcutaneous tissue, from the bones and periosteum, in glands and the viscera. When they grow from the glands, they resemble in structure normal lymphatic gland-tissue, and by some are

Round-celled sarcoma.

described as a distinct variety—the lympho-sarcomata. Another variety is described as the *glioma*, and much resembles the preceding in the smallness of its cells. It always grows from the neuroglia or connective tissue of nerve structures, especially in the retina. Virchow has described another form of sarcoma belonging to this group, to which he has given the name of *psammoma*, from the fact of their containing calcified globes, which resemble the 'brain-sand' found in the pineal gland. These growths are for the most part attached to vessels, and have been found only in the brain and orbit.

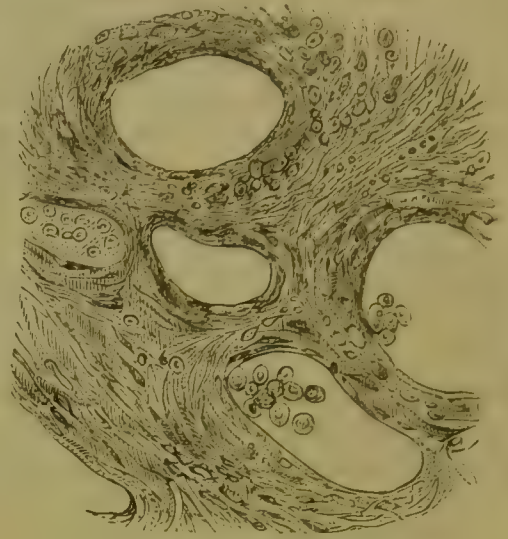


FIG. 169. Round or oval-shaped sarcoma. From a tumour of the female breast, described in 'Path. Trans.' vol. xix. pp. 394-397, and figured in the same volume as pl. xii. fig. 6.

Spindle-celled sarcoma.

II. The spindle-celled sarcomata are composed of small elongated cells (oat- or awn-shaped), sometimes without any intercellular substance, at other times united by a homogeneous, fibrillar, or fibrous tissue (Fig. 170). When there is no matrix the cells lie in close apposition, and are often arranged in the form of trabeculæ, giving the growth a fasciculated appearance; and under these circumstances the tumour may be mistaken for a fibroma. The cells vary in size in different tumours, but are generally pretty constant in size in any given tumour. This has led to the division of these growths into two classes, which are named respectively the 'small' and 'large' spindle-celled sarcomata. In the former, the cells are often not longer than the diameter of a white blood-corpusele, and these tumours are usually hard and firm, and their matrix is distinctly fibrous. The large spindle-celled sarcomata are softer and more brain-like, their cells being five or six times as large as in the other variety. The spindle-celled sarcomata are usually found in the subcutaneous tissue, or growing from fasciæ or periosteum,



FIG. 170. Section from a spindle-celled sarcoma of the femur, taken from the exterior of the tumour. *a* shows the 'indifferent granulation material' or 'adenoid tissue' stretching out from the tumour structure (*b*) into the adipose tissue (*c*) separating its cells. The tumour was of a malignant character, and contained in other parts of its substance cartilaginous and osteoid material. ('Path. Soc. Trans.' vol. xxi. p. 341, and pl. viii. fig. 1.)

especially the periosteum of the shafts of the long bones and the bones of the face. They are also found in connection with the breast, testicle, and eye.

In connection with spindle-celled sarcoma may be mentioned a very interesting and definite group of sarcomatous tumours, which consist usually of the spindle-celled variety, but are sometimes composed of round-celled. These have been named the melanotic sarcomata, from the fact that the cells contain a large quantity of dark-coloured pigment granules, which gives to the tumour a dark-brown or black colour of varying intensity. It may be that only parts of the tumour, and those generally at the periphery of the growth, are

Melanotic
sarcoma.

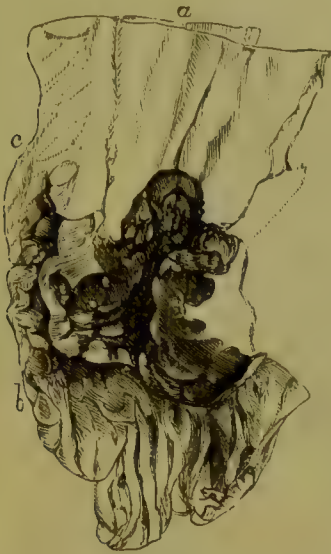


FIG. 171. Melanosis, springing from the mucous lining of the urethra. *a*. The urethra laid open. *b*. The prepuce. *c*. The section of the corpora cavernosa. The disease was removed by amputation. The man lived for some years, and died of another affection.—St. George's Hospital Museum, Ser. viii. No. 10a.

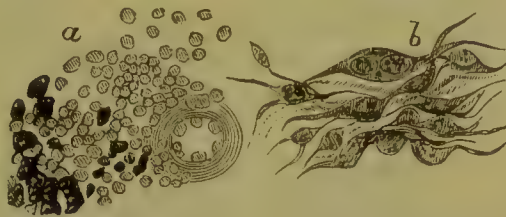


FIG. 172. The cells which were found in the microscopic examination of the tumour shown in the previous figure. *a*. Section from the peripheral part of the growth showing 'indifferent' or 'granulation tissue,' with isolated pigment-cells among it. At one point a blood-vessel is seen. *b*. A portion of the growth more highly magnified, showing large spindle-shaped branching cells, many of them quite filled with pigment.—From a drawing by Dr. T. H. Green in the 'Path. Soc. Trans.' vol. xxiii. p. 176.

thus pigmented. These tumours are usually developed from structures such as the eye or the skin, where pigment is always or commonly found in the

natural state. When occurring in the skin it seems often to originate in a mole. It also originates in parts where no pigment naturally exists (Figs. 171, 172). It differs from other sarcomata generally in its tendency to prolong itself along the lymphatics, so that in a very early stage of this disease it is usual to find the nearest set of lymphatic glands implicated in the disease; and, furthermore, it is not unusual to find secondary growths springing from the lymphatic vessels leading to these glands. It is one of the most malignant of all tumours, causing secondary growths in the internal organs, and speedily destroying the patient.

It may be convenient here to mention another class of tumour to which the name 'alveolar sarcoma' has been given, and which in their histological characters resemble much more the car-

Alveolar
sarcoma.

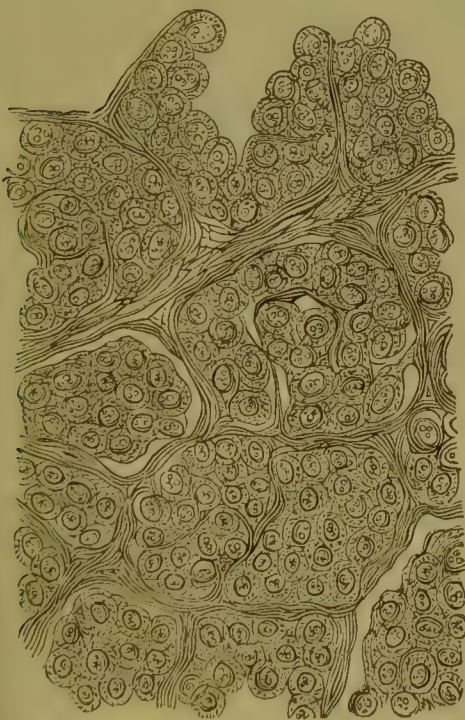


FIG. 173. 'Alveolar Sarcoma.'—After Billroth.

cinomata, from which it is often difficult to distinguish them by their microscopical characters, but which can be distinguished by their difference in

origin, and by the fact that in the same tumour there are often portions composed of typical sarcoma tissue. They differ from the other sarcomatous tumours in the fact that the cells, which may either be round or spindle cells, are contained in separate alveoli, formed by bundles of connective tissue. Frequently, however, fine filaments may be discovered coursing between individual cells, which is never the case with the carcinomata (Fig. 173).

Cylin-
droma.

I may refer here to a peculiar class of tumours called Cylin-droma by Billroth, and to which other names have been applied by other pathologists.¹ The characteristic anatomical feature in these tumours is that they contain long cylinders, sometimes perfectly structureless, in other cases filled with roundish or radiate or spindle-shaped cells (Fig. 174). These cylinders have been believed to be modifications of the rudimental connective or mucous tissue, or of the rootlets of the lymphatic vessels. According to Paget, such structures may occur in tumours in different regions of the body, and the growth may be

entirely innocent, or recur in the scar after operation. In the only case which I have myself treated, the tumour

was of a most obstinate nature, but was, I believe, ultimately and finally eradicated by a combination of the knife and cautery. It formed in the

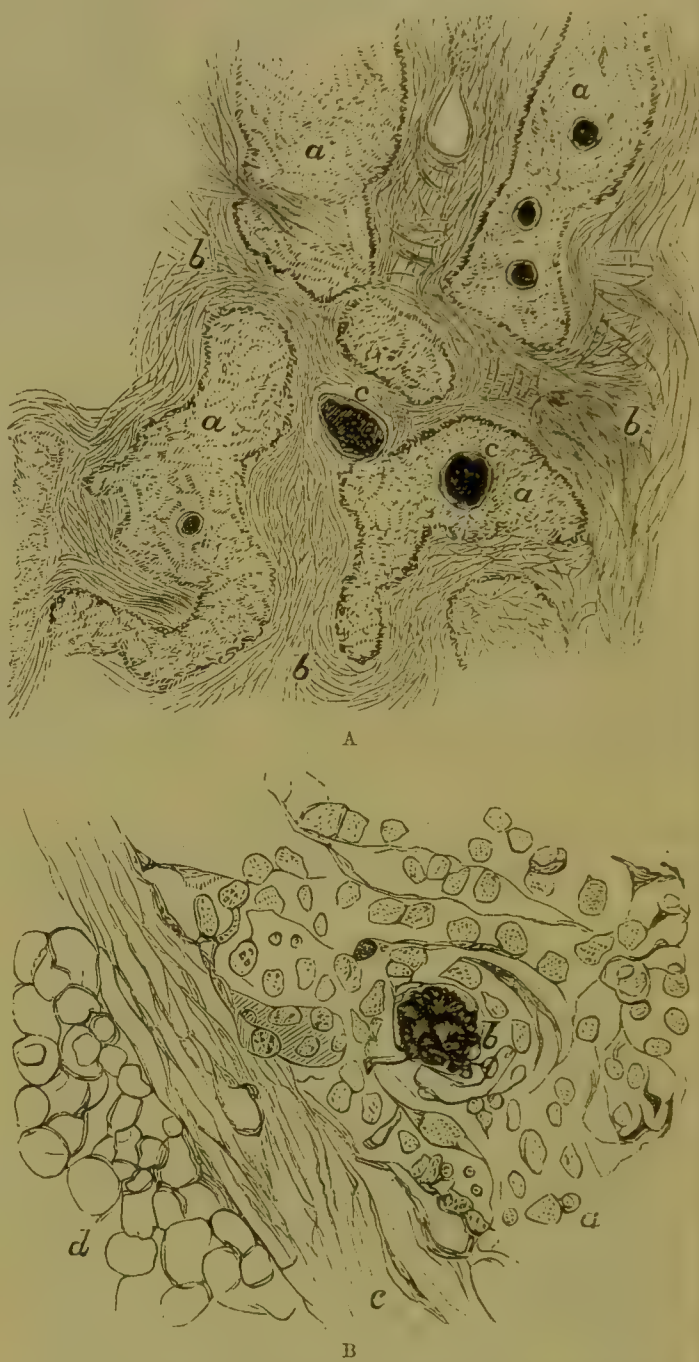


FIG. 174. Cylin-droma. A. A sketch to show the general arrangement of the elements of the tumour; a, the cylinders, filled with epithelial cells; b, the fibrous tissue separating them; c, masses of cells arranged in a bird's-nest form. B. A more highly magnified preparation of the cells contained in the cylinders; a, indifferent cells, of the 'granulation' type; b, one of the bird's-nest masses; c, fibrous tissue; d, fat. From a preparation by Dr. Watney, taken from the case referred to in the text.

¹ Cylindrical cartilaginous tumour; mucous canceroid; cylindrical sarcoma; siphonoma. See Paget, 'Lectures on Surgical Pathology,' 3rd ed. p. 472. Mr. Butlin remarks that the name 'Cylindroma' has led to a confusion between this form of tumour and the cylindrical form of epithelioma, with which it has nothing in common.

scalp after a wound received in the trenches before Sebastopol, and was not finally cured till the year 1876. The cylindrical elements were not recognised till the final operation; but the man was under my treatment for many years.

III. Occasionally it is found in the examination of any given tumour that the cells, instead of conforming pretty accurately either to the round-celled or spindle-celled type, consist of a mixture of the two. This has necessitated the formation of a separate group of 'mixed-celled sarcomata,' which, as their name implies, consist of cells of various forms. They are most often found in connection with bones.

Mixed-celled sarcoma.

IV. Giant-celled sarcoma or myeloid tumour (Fig. 175) is that variety of sarcoma in which the cells distinctive of the form of tumour are very large, contain numerous nuclei (sometimes as many as twenty or thirty), and are often provided with numerous offshoots. These cells are likened to those which occur in the marrow of foetal bones. Such cells are found mixed up with the tissue of any of the other forms of sarcoma, so that the growth is

Myeloid sarcoma.

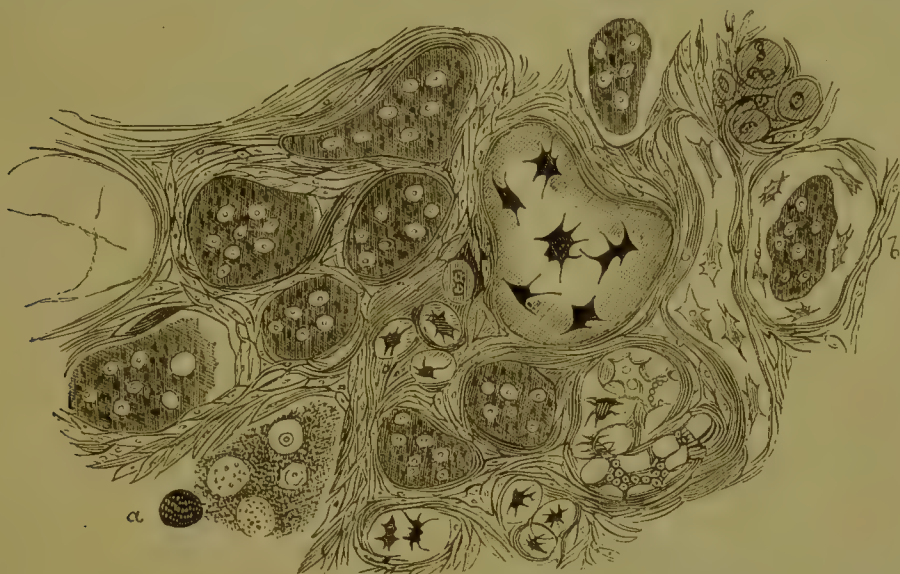


FIG. 175. 'Giant-celled Sarcoma,' or myeloid tumour.—After Billroth. *a* points to a part where cysts were being formed by the softening of the tissue of the tumour; *b*, to a focus of ossification.

formed partly of round, spindle, or mixed cells in addition to the large 'myeloid' cells. They are found in tumours which spring from the interior of bones.

Sarcomatous tumours may undergo either a degenerative or developmental change. The former may consist either in a fatty degeneration or a calcareous change, or they may undergo mucoid softening, with the development of cysts. In addition to this, cysts are of frequent occurrence in some forms of these tumours, as a natural condition of their growth. These tumours constitute the class of cystic sarcomata. A far more important change which sarcomatous tumours undergo is of a developmental character. The structure of which they are composed, being an embryonic tissue, may undergo a process of development into one of the complete forms of connective tissue, namely, fibrous tissue, cartilage, or bone; and this transformation may be so complete that the whole of the tumour, except a thin coating of sarcoma, will consist of fibrous tissue, cartilage, or bone, as the case may be; the original tissue of the tumour undergoing development almost as soon as it is formed. Such tumours are the badly-named chondrosarcoma of the testicle and the osteo-sarcoma of bone, which, apparently to

Changes in sarcoma.

the naked eye, consist almost entirely of cartilage or bone, but are really to be regarded as veritable sarcomata, which structure always exists in them, though perhaps to a very limited extent; for they always run the course of these growths, and not the more innocent course of the structure of which they are apparently composed.

The naked-eye appearances of the sarcomata are very various; some are creamy white, dotted over with minute extravasations, and resemble brain-matter; others are gelatinous, and resemble ordinary size; and others again reddish brown, and fleshy in appearance. Generally they are well defined, and present a well-marked, rounded outline, which gives them the appearance of being encapsuled; but only in a very few instances is there really a definite capsule. In some of the more rapidly growing sarcomata, the growth infiltrates surrounding parts, without any defined border. The surface of the cut section is homogeneous, and presents no appearance of intersecting fibrous bands such as are seen in the carcinoma. It often presents extravasations of blood, some recent, of a bright red colour; others old, causing brownish patches of pigmentation scattered over the surface of the section.

It is impossible to describe the clinical characters of the sarcomata, so infinitely do they vary, and present the greatest diversities as regards the parts from which they grow, their consistency, their rate of growth, and their liability to recurrence. Both sexes and all ages are liable to them; for though they are more common in adult life, still they are not unfrequently found in quite young children. Indeed sarcoma is probably the only form of malignant disease which occurs in childhood. As regards their consistency, sarcomata may vary from tumours of the hardness of bone to the softness of an ordinary lipoma. The rapidly growing sarcoma which has not undergone any secondary change is usually soft; whereas, of course, those tumours which have undergone the developmental change into cartilage or bone, spoken of above, are as hard, or nearly as hard, as innocent examples of osteoma or enchondroma. There is, however, one important characteristic about the consistence of sarcomatous tumours which requires to be borne in mind, and that is that it varies in different parts of the same tumour; and this point will often afford an important aid in arriving at a diagnosis.

Sarcomatous tumours develop wherever there is connective tissue; that is to say, from almost any part of the body. There are, however, certain situations where these tumours are more prone to occur than others. As, for example, in the subcutaneous connective tissue and the intermuscular fasciæ, where we usually get spindle-celled sarcomata: the connective tissue of bone—the spindle-celled or mixed-celled growing from the periosteum, and the myeloid-celled from the connective tissue of the interior of bones: the connective tissue of certain glands—the breast, the parotid and the testicle; and the connective tissue of nerve centres, where we find the glioma. In the mixed sarcomata, the name given usually indicates the structure from which they grow; thus the lympho-sarcomata originate in the lymphatic glands; the myxo-sarcomata in the mucous cavities, as the antrum; the chondro-sarcomata from the articular ends of the long bones: these latter tumours have been found also in the parotid and the testicle.

The rate of growth of sarcomata varies. As a rule they grow rapidly; but some tumours may exist for years, and only make slow progress. Generally it will be found that after they have grown to a certain size they begin to

increase with greater rapidity ; and when secondary tumours have appeared they are always found to grow rapidly.

All sarcomatous tumours must be regarded as malignant, but the amount of malignancy varies very greatly : some growths—as, for instance, the melanotic sarcoma—are amongst the most malignant of tumours as regards their general infecting properties ; though probably not so locally malignant as some other forms, since a melanotic sarcoma thoroughly removed may not return in the cicatrix. Other growths show a marked tendency to local recurrence, without any general dissemination of the disease. This is especially noticeable in the spindle-celled sarcomata occurring in the subcutaneous tissue, and which led to their formerly being termed the ‘recurrent fibroid tumours’ ; as in a case admitted into St. George’s Hospital some years ago, in which a patient with one of these tumours in the arm, about the insertion of the deltoid, had had it removed twenty times in the course of five years, and in whom the arm was eventually removed at the shoulder-joint ; the growth recurred in the cicatrix, but without any secondary infection in other parts of the body. Other sarcomatous tumours, as the myeloid, show much less tendency to recur ; as, for instance, in a case of myeloid disease which was growing with great rapidity and had attained an enormous size owing to the patient’s reluctance to submit to operation, in which I amputated the thigh eleven years ago, and in which there has been no recurrence.

The diagnosis of sarcoma is often very difficult. The rapidity of this growth is that which more than anything else distinguishes it from the purely innocent tumours : this, together with the unequal consistence of the tumour, and the fact that the part affected is one in which sarcomatous tumours are prone to occur, constitute our principal means in distinguishing them from innocent tumours. With regard to the diagnosis between sarcoma and carcinoma at an early stage, i.e. before any glandular affection has been developed and before the skin has given way—it can hardly, I think, be established definitely—the greater mobility of the tumour and the freedom with which the skin moves over it ; the absence of any implication of the lymphatic glands ; possibly the presence of cysts ; the situation of the growth, and the age of the patient, are the principal diagnostic points in determining between the two ; which, however, is not a matter of very vital importance, since removal is indicated in both, and the diagnosis can be verified at the time of the operation by an exploratory incision and the future proceedings shaped accordingly. Sarcomatous tumours when ulcerated much resemble carcinoma ; the diagnosis between them is chiefly made by the amount of infiltration of the surrounding skin. A tumour which fungates out of a clearly cut hole in the skin is probably sarcomatous ; one in which the tissue of the skin around the hole is oedematous, hardened, and studded with nodular masses, is in all likelihood carcinomatous ; and the diagnosis of carcinoma becomes established if the glands are implicated.

The prognosis of sarcoma varies with the variety of the growth and the seat of the disease. The chief indication of the probability of recurrence is drawn from the rapidity and from the succulence of the growth. Rapidly growing soft tumours are regarded with much more apprehension than those of firmer consistence and slower increase. In any case, the prognosis is better if the tumours have been very early and very freely removed. Even after one or more recurrences the case is not absolutely hopeless. Cases are on record where, after the second or third removal, no further development of the disease has taken place ; and such cases render it the plain duty of the surgeon

to interfere, and at the earliest possible moment, when recurrence is ascertained ; though, as a rule, a tumour which has once recurred will go on doing so, and the more rapidly it recurs the more rapidly it will, in all probability, ulcerate ; and, as a general rule, the oftener it has been removed the shorter will be the patient's next respite.

There is but one treatment for sarcoma, and that is removal of the growth ; and in these cases it is always wiser to remove not only the tumour but the tissues in the vicinity of the disease to as wide an extent as possible. Thus, even in a central sarcoma of bone, which is one of the least malignant forms, if it occurs in one of the extremities, it is better to amputate the limb some distance above the disease than to attempt to shell out the growth and scrape the cavity. In a sarcoma of the breast, it is wiser to remove the whole gland than to simply dissect out the tumour. As a rule, the removal should not be attempted unless the whole of the disease can be fairly extirpated.

Carcinoma.

Carcinoma is defined anatomically as a tumour which is composed of an areolar framework of fibrous tissue, within which areolæ are contained collections of cells bearing a considerable resemblance to those of epithelium, and believed by most modern pathologists to be developed from that structure, so that they deny the possibility of *carcinoma* taking its origin anywhere except on the surface of the body, whether external or internal, including, of course, in the surface the deeper layers of the epithelium and all the involutions formed by ducts, follicles, &c. ; though no one denies that malignant disease originates in situations such as the interior of bones, in the substance of the brain, and innumerable other localities far away from any pre-existing epithelium.

Taking this definition of carcinoma, it would be defined as consisting of a network of fibres in which may be found the nuclei peculiar to connective tissue, and contained in these areolæ a mass of cells varying in shape, size, and special characters in different examples, and even sometimes in the same example of the disease, but all of them bearing some resemblance, more or less distinct, to the normal epithelium. The cells show no tendency to pass into a higher stage of development, as those of sarcoma do, nor have they any organic connection with the fibrous stroma. On the contrary, they are marked by a tendency to fatty degeneration and often contain oil-globules, and the whole tumour tends more or less rapidly to degeneration and ulceration.

Carcinoma is prone to affect the lymphatics leading from the part in which it was originally developed ; so that the glands next in order are very commonly found to be the seat of a similar tumour ; and this glandular formation, when confined to the glands immediately connected with the primary tumour, is by many surgeons considered rather in the light of a portion of that tumour than as an extension of the disease. And certainly the disease often stops for a time at these first glands. But from this first range of glands it will pass either to more remote glands or will infect the mass of the blood and reappear in the remotest parts of the body. Meanwhile the primary tumour has been locally infecting the tissues in its neighbourhood, and thus making its way to the surface either of the skin or of a neighbouring serous or mucous cavity. In its course it breaks down, as above stated, so that its structure presents traces of fatty degeneration in the form of small dots of a yellow cheesy consistence, visible to the naked eye, and in the presence of a creamy juice (so-called 'cancer-juice') which can be scraped or squeezed from its section. When the disease has made its way to the surface an indolent ulcer is formed, with hard, elevated edges, the cancerous material

being infiltrated into the integument for a variable distance, the surface of the ulcer varying in character according to the form of the disease. These cancerous ulcers are very prone to hæmorrhage, and the patient's life, if not cut short otherwise, is gradually worn out by the bleeding and the exhaustion of the discharge. Carcinoma kills, however, in many other ways. The growth of the primary tumour interferes with the functions of vital organs; or the disease is propagated into one of the great viscera; or it infects the mass of the blood, causing a peculiar cachexia, which sometimes proves fatal without any obvious mechanical cause.

The forms into which carcinoma is divided are as follows:—

1. Hard cancer or scirrhus—carcinoma fibrosum—hard spheroidal-celled carcinoma (Butlin)—is found commonly in the breast and alimentary canal, especially at the pylorus. This variety is distinguished by its stony hardness (hence popularly called stone-cancer); it feels like a lump of some hard foreign substance let into the part; as it grows its structure often shrivels, so as to draw the neighbouring tissues to it, producing an apparent loss of size, glueing the integument to the surface, and causing the dimple of the skin

Scirrhus.

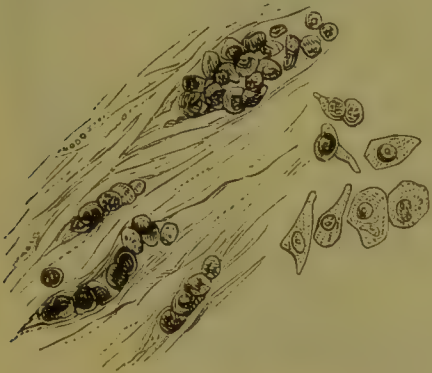


FIG. 176. Microscopic appearance of scirrhus of the breast (after H. Arnott). 'The typical form of hard cancer. To one side of the section are drawn a few detached and larger cells from another specimen of undoubted scirrhus of the breast, showing more clearly the varying size and shape of these cells and their occasional multiple nuclei.' ('Syst. of Surg.' vol. i, fig. 13, opposite p. 614, 2nd ed.)

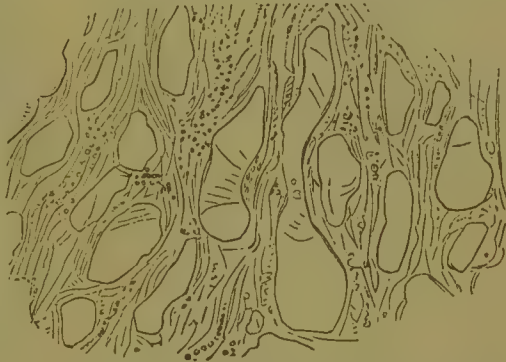


FIG. 177. Cancer stroma (after H. Arnott). 'A very thin section was made, through a tolerably firm pink-white cancerous nodule, in the liver of a patient dying with hard cancer of the breast, and the cells brushed away with a camel's-hair pencil under water. There is thus left the typical stroma dimly fibrillated and granular, enclosing meshes which have been closely filled with cells.' ('Syst. of Surg.' *ibid.* fig. 18.)

so often seen in this form of cancer, and the retraction of the nipple which so commonly occurs when it is situated in the breast. Stretching out from the main tumour may often be found indurated strings, being the cellular tissues infiltrated and drawn in towards the tumour.

When cut into, scirrhus presents a characteristic hardness, feeling like a raw potato does when cut; its section is whitish or greyish, dotted with minute yellow points, and its surface often presents a concavity caused by the shrinking of the tumour. The tissue of its exterior passes into that of the healthy structures without any exact or defined margin.

Examined microscopically, it shows a stroma which is often extremely definite—the cells are 'of an epithelial type, of varying size and shape, but with tolerably uniform (and usually single) large nuclei, closely packed in the meshes of a stout fibrillated stroma, without any visible intercellular elements.'¹ The stroma, which many pathologists regard as merely the compressed connective tissue of the part, is believed by Mr. Arnott to be, often at any rate, a new formation.

This form of scirrhus, collected into a separate nodule, is called the *tuberous*

¹ H. Arnott, in 'Syst. of Surg.' 2nd ed. vol. i. p. 614.

form; the other is the *infiltrating*, in which the cancer appears more as a general induration of all the tissues in the neighbourhood, the skin being thickened, tense, and livid, and adhering closely to the parts below ('hide-bound cancer'); the disease spreads slowly and superficially, ulcerating in one part, and possibly afterwards healing there while spreading in other parts.

The ulceration of a scirrhus tumour leaves a sluggish sore, with sharp edges, bounded to a variable distance by cancer tissue, sometimes with a nearly flat surface, at others with prominent granulations, and with a peculiar foetid discharge, the smell of which much distresses the patient, and which is mixed with more or less blood from time to time. Such ulcers may heal for a time, leaving a thin livid scar, very prone to break down again.

Medullary
cancer.

2. The next variety of carcinoma is the encephaloid, medullary, or soft cancer—soft spheroidal-celled carcinoma (Butlin)—in which the cells are more plump, rounded, and usually more uniform in size and shape, and the alveolar stroma less distinct. This form of cancer is often secondary to scirrhus, so that a primary scirrhus tumour in the breast will be accompanied by the growth of medullary carcinoma in the glands or viscera. It grows much more rapidly than scirrhus, is often exceedingly vascular, so that large blood-cysts are formed in the interior of the tumour, and its surface is very commonly permeated by large veins. To the most vascular examples of this form of cancer Mr. Hey's name, '*Fungus hæmatodes*,' is still occasionally applied. This form of cancer differs from scirrhus in the greater softness of the whole mass (whence the name), in the relatively smaller proportion of the intercellular substance, in the greater juiciness of the tumour, and the more rounded shape, larger size, and more varying form of the cells.

The favourite seats of encephaloid cancer are the female breast, the eye, the testicle, and less frequently the ovaries, bladder, and other viscera. Its nature is often overlooked at first, it being mistaken for innocent tumour, or for abscess, from its extreme softness when not covered by any hard tissue, or for chronic inflammation in the testicle when bound down by the firm tunica albuginea. It rapidly affects the glands, and when removed it generally rapidly recurs, so that the prognosis is even more unfavourable than in scirrhus. When left to itself the tumour speedily makes its way through the skin, ulcerates, and bleeds copiously. If death is not caused in this way it is occasioned by the rapid growth of the tumour.

Epithe-
lioma.

A third form of cancer is the squamous-celled carcinoma or epithelioma. This form of cancer takes its origin from the epithelium of the part in which it grows, and is therefore always developed from the surface or from the parts in contact with the surface of the skin, or mucous mem-

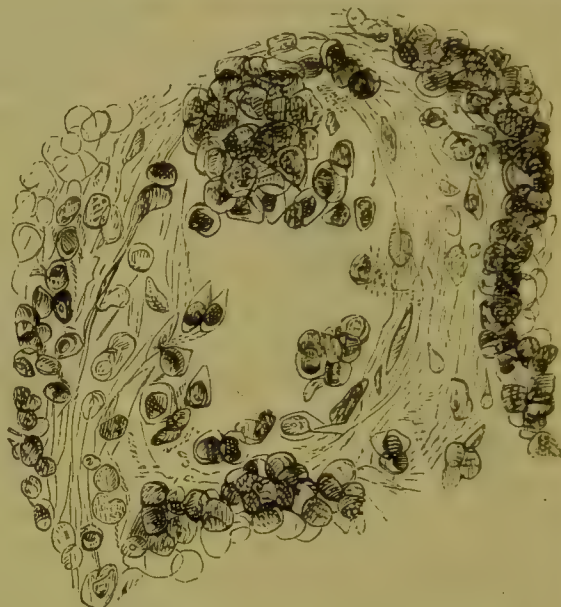


FIG. 178. Medullary cancer. 'From a lymphatic gland—secondary to hard cancer of the breast. This form of cancer differs from scirrhus only in the proportion of the cell element to the fibrous stroma—the cells being here seen to be still of the epithelial type, and lying close together, without any visible intercellular substance.'—From Arnott, *ibid.* fig. 15.

brane, which is covered with squamous epithelium. A favourite seat of epithelioma is the orifice of some cavity (mouth, anus, vagina, urethra), where the skin and mucous membrane become continuous. It usually appears as a hard flattened lump, the surface of which easily breaks down and ulcerates, and which readily affects the nearest glands. Its connection with simple inflammation is very close; the continuous irritation of some foreign substance is an undoubted cause of the disease, as, for example, that of a clay pipe in causing epithelioma of the lip or tongue,¹ of soot in the rugæ of the scrotum in causing chimney-sweep's cancer, of retained secretion under a phimosed prepuce in causing epithelioma of the penis. And the enlargement of the glands is often due merely to ordinary inflammation, and will subside completely after the removal of the tumour. On microscopic examination it will be found to be composed of cells arranged in the form of irregular cylinders communicating with each other. The cells, which are of the type of scaly epithelium, are arranged in concentric laminæ, those forming the wall of the cylinder consisting of large flattened cells, whilst in the centre

the cells are rounder. The cylinders on cross-section present the appearance of round or oval masses, not unlike in appearance to a bird's nest. They have hence been termed 'cell-nests.' The cylinders are connected together by a fibrous stroma, in which the vessels are contained. It should be noticed that the bird's-nest arrangement of the epithelial cells, though very characteristic of epithelioma, is not peculiar to it. 'Similar cell-nests are formed in other morbid structures—in papilloma, for example—and they exist even in normal epidermis. In the epidermis of the tongue exquisite specimens of cell-nests may often be discovered' (Butlin). Epithelioma is

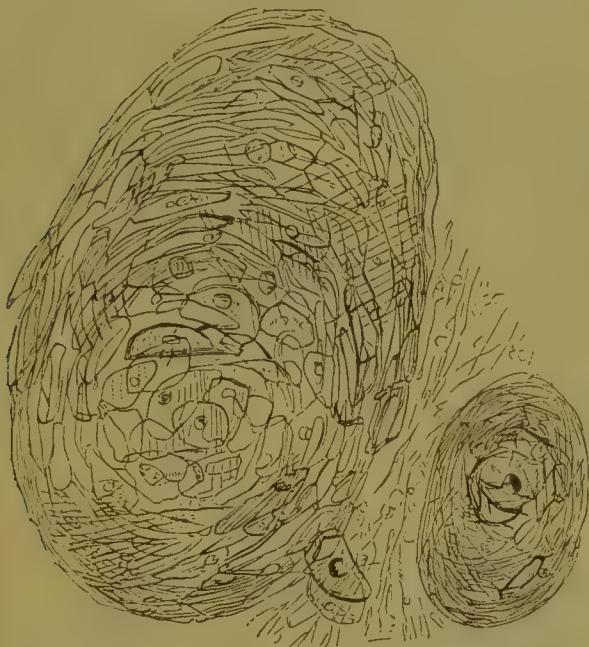


FIG. 179. Epithelioma. 'A section through a chimneysweep's cancer of the scrotum, representing two nests ("laminated capsules," "globes epidermiques"), the larger one displaying the structure of these bodies—plump epithelial cells in the midst, surrounded by drier and flattened scales; whilst the smaller shows a more common appearance, the cells being so flattened and altered as to resemble a ball of hair; both nests were embedded with numerous others in the subcutaneous tissue.'—From Arnott, *ibid.* fig. 21.

especially prone to break down and ulcerate, and is the form of cancer which usually gives rise to the cancerous ulcer described in a subsequent chapter.

Epithelioma, although it appears to me to realise more exactly than any of the other forms of cancer the anatomical descriptions of carcinoma which are accepted at the present day, in the distinct derivation of its cell-forms from the epidermal tissues, and the completeness of its fibrous stroma, yet is commonly much less 'malignant' than the other forms of cancer; i.e. it

¹ Cancer of the tongue is rarely seen in the female sex, and cancer of the lip hardly ever; but a distinguished surgeon at Edinburgh told me that he had seen numerous examples of cancer of the lip among the Irishwomen of that town, who are constantly smoking short clay pipes.

destroys life less quickly, and after removal it returns much less speedily, and often, as it seems, does not return at all. Its removal, therefore, is a matter of urgent necessity; and a more encouraging prognosis may be given than we can honestly give in scirrhus or soft cancer.

Cylindrical
or columnar-celled
carcinoma.

Another form of carcinoma is regarded by some as a variety of epithelioma, in which the cells, instead of being of the squamous type, as in the ordinary epithelioma, are of the columnar type; and the disease is by them termed columnar-celled epithelioma; but as there is an absence of cell-nests, which by some is regarded as characteristic of this form of carcinoma, it seems better to class them as a separate form of cancer, under the name of cylindrical or columnar-celled carcinoma. They originate from cylindrical epithelium, and are found, therefore, in connection with those mucous surfaces which are covered with this variety of epithelium, as the alimentary canal, and more especially the rectum and the uterus. Microscopically, they are found to be composed of tubules lined with columnar epithelium, together with masses

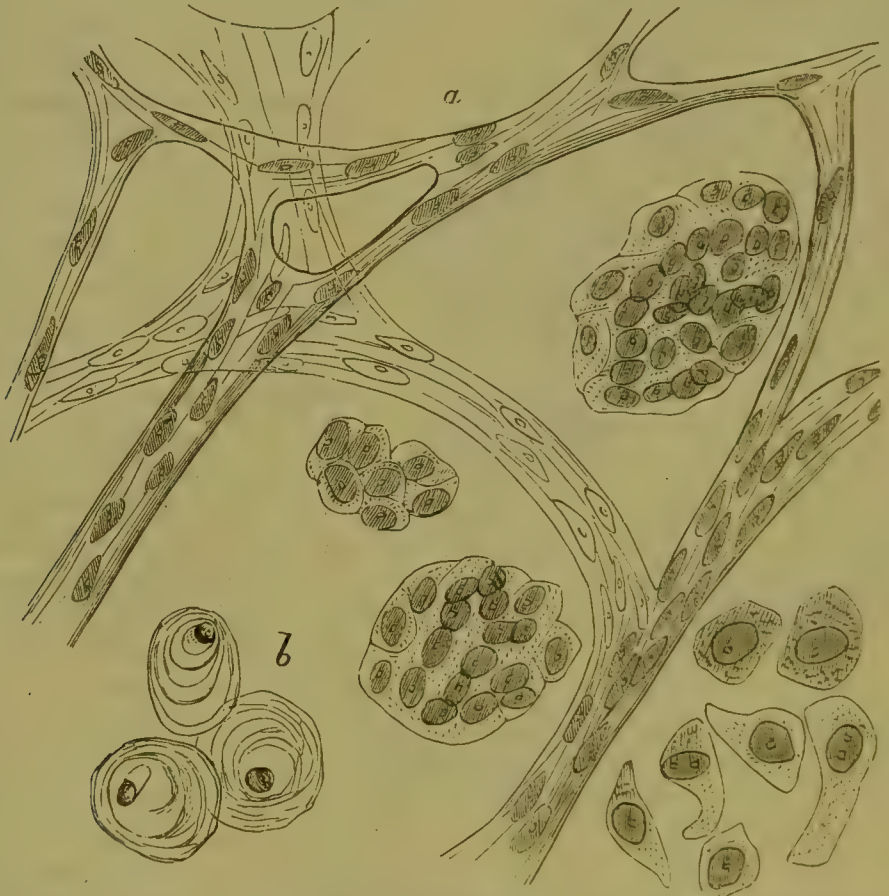


FIG. 180. Colloid cancer. *a*. From a drawing by Mr. Arnott, in 'Path. Soc. Trans.' vol. xxiii, pl. 10. It shows clusters of cells of the epithelioid type (those at the right hand of the drawing very large and irregular in shape), floating in spaces bounded by a delicate fibrous network, which forms large oval and spherical meshes. This stromal tissue is closely beset with elongated oval nuclei. *b*. Also from Arnott, in 'Syst. of Surg.' 2nd ed. Fig. 23, shows some cells which are very characteristic of colloid cancer—'round or oval, mononucleated, and having within the outer cell-wall several very delicate concentric lines, giving to the cell somewhat of an oyster-shell appearance.'

of cells grouped in an alveolar stroma, as in the ordinary carcinomata. They form indurated masses in the walls of the canal in which they are situated, which ulcerate early and infiltrate the deeper tissues.

Colloid.

Another form of tumour was formerly classified as a separate variety of carcinoma, under the name of colloid cancer. It is probable, however, that it is merely a degeneration of one of the preceding variety of carcinoma, especially the spheroidal-celled form. Its synonym is alveolar cancer, derived

from the arrangement of the fibres of its stroma in large open meshes of transparent fibres, in which are seen rounded or oval nuclei. Lying in the interstices of these fibres is a transparent jelly-like substance, in which will be seen under the microscope cells of various sizes and shapes, the most characteristic being large, round, and flat, formed of a nucleus around which are numerous concentric laminae, very much like an oyster-shell; besides which there are others which approach more or less closely to the forms usually seen in epithelioma (Fig. 177). The favourite seat of colloid is the peritoneum, especially its omenta; though it is found also in the female breast, in the limbs, the rectum, and the face.

Villous tumour was formerly described as a cancer, but its anatomical structure and its course are entirely different, and it is now almost universally allowed to be not cancerous. Nevertheless cancers may be covered with a villous growth and present the appearances of ordinary villous tumour. The anatomical difference would rest on the presence or absence of cancer underlying the villous surface. Villous.

CHAPTER XVIII.

SCROFULA.

SCROFULA is a term which is not very clearly defined, and up to quite recent times has been used rather to express the idea of a diathesis than of a disease. The most common definition of it which has been given is that it is a constitutional condition predisposing to the occurrence of a low form of inflammation of a peculiar type, affecting certain tissues or parts. In the most intelligible sense of the word, and in the class of cases which are most easy to diagnose, scrofula or its synonym, struma, is the constitutional diathesis which leads to (or which tends to lead to) the deposit of a substance called 'tubercle' in various organs of the body. Its relation to tubercle has been a source of endless controversy. Recent observation has done much to clear up the matter, and there seems to be sufficient reason to believe that the two diseases are pathologically identical, however much they may differ in their clinical manifestations. That they were connected in some way or another has been long admitted; for it has been abundantly proved that any tubercular condition in the parent may produce scrofula in the children. Then, again, the presence of the morbid structure presently to be described as tubercle has been repeatedly demonstrated in scrofulous inflammations, in glandular enlargements, in rarefying ostitis, in 'white swelling' of joints, in lupus, and in many other diseases regarded as scrofulous. And, furthermore, the fact that strumous inflammations were essentially tubercular has been proved experimentally by the inoculation of the products of scrofulous diseases into certain of the lower animals, and the production of a disease exactly similar to acute tuberculosis in man. The discovery by Koch in 1882 of the tubercle bacillus did much to strengthen the position. He believed that this bacillus was the actual virus of tubercle, and performed many experiments by cultivating the micro-organism in blood serum to prove that this was so. Since this time the bacillus has been found in what would be undoubtedly considered as scrofulous inflammations—fungous granulations from an ordinary white swelling, strumous ostitis and such-like; and it has been proved experimentally that bacilli obtained from such a source, if cultivated and then inoculated, produce an exactly identical disease with those obtained from an undoubted miliary tubercle.

It would seem, therefore, to be abundantly proved that the two diseases, scrofula and tuberculosis, are pathologically identical. But in their clinical manifestations there is the widest possible difference; between, for example, a case of acute tubercular meningitis, running its course in a few days, and a case of chronic strumous bone-affection, lasting perhaps for years. But to a great extent this may be the difference between an acute and a chronic disease, and the two are connected by insensible gradations. Take, for example, an ordinary case of phthisis. This is always regarded as a tubercular affection; but still, as Mr. Treves has shown, there is the very closest alliance between scrofula and phthisis: the broken-down cavity in scrofulous caries, or a strumous gland, and a vomica in the lung are apparently identical, and the histology of the two processes is the same. And, moreover, the

etiology of the two affections is the same. Both diseases may be inherited, or acquired from the same causes. So close is the identity, in Mr. Treves' opinion, that he has termed phthisis pulmonalis 'scrofula of the lung.' The differences in the clinical manifestations of the two diseases, scrofula and tuberculosis, would appear to be due mainly to differences in the recipient of the *materies morbi*, and partly, no doubt, to modifications in the *materies morbi* itself; for, as Nélaton has shown, the material obtained from a fungating scrofulous gland, though capable of producing tuberculosis, is not so virulent as ordinary tubercular matter. If we adopt Koch's views in their entirety, and believe that the tubercle bacillus is the actual virus of tubercle, we believe that the bacillus or its spores is introduced by the lungs or alimentary canal. If the recipient is perfectly healthy the virus is eliminated or destroyed without producing any ill-effects. If, on the other hand, the patient possesses that peculiar general condition which presents a soil favourable for the reception and growth of the bacillus, it germinates and produces either tuberculosis or some scrofulous manifestation; but the reason why the one or the other condition is produced is not as yet known. There can be no doubt that the age of the individual has an important bearing on the determination of the affection; scrofula being essentially a disease of childhood. But the most important factor in causing local scrofulous diseases appears to be some lowered condition of the vitality of the part, either as the result of injury or chronic inflammation. The experiments of Schüller on this point are very conclusive. He caused certain animals to respire finely divided tubercular matter, so as to ensure the introduction into the system of the *materies morbi* of tubercle through the lungs. He then produced certain injuries in these animals, generally contusing a joint; and though the animals were apparently healthy when the experiments were performed, he succeeded in most cases in setting up an ordinary scrofulous joint-affection. The explanation we should offer, therefore, is that in scrofulous inflammations, the *materies morbi* of tubercle, probably the tubercle bacillus, is introduced into the blood through the lungs or alimentary canal, and in its circulation in that fluid finds a soil suitable for its needs; this suitable soil generally being some tissue which has been weakened by injury or previous disease. Here it germinates and sets up a peculiar form of chronic inflammation which we recognise as scrofulous inflammation. Furthermore, it may be said that there are certain tissues which in their natural healthy state present a soil or conditions more favourable to the growth of the virus of tubercle and the occurrence of scrofulous inflammations than any others. These tissues are (1) the skin; (2) mucous membranes; (3) lymphatic glands; (4) joints; (5) bones.

Tubercle is described as being of two kinds, the grey or miliary, and the yellow or crude. The latter is now regarded by most authors—following the authority of Virchow—as a secondary stage of the former. Grey or miliary tubercle is 'a greyish-white, translucent, non-vascular body of firm consistence and well-defined spherical outline, usually about the size of a millet-seed. Although in its earlier stage it is uniformly translucent, its central portions quickly become opaque and yellowish, owing to the retrograde metamorphosis of its component elements.'¹ The grey miliary tubercles themselves are described by Mr. Treves as an aggregation of smaller bodies, which are designated 'lymphoid,' or 'reticular,' or 'primitive' tubercles, and the microscopic structure of which he thus describes:—

Tubercle

¹ 'Green's 'Pathology,' pp. 146-7.

'Speaking generally, the structure of this elementary tubercle is as follows: It forms a roundish microscopic mass of cells that may be divided into three zones. The central zone is represented by one or more giant cells, the next zone is composed of a number of large cell-elements with clear and pellucid contents and that have been somewhat erroneously termed "epithelioid," and the most external zone consists of a mass of leucocytes. The cells forming the little district are supported by a more or less distinct reticulum, and with this reticulum the branched processes of the giant cells (when such processes exist) are said to be continuous. The altered tissue fuses gradually into the surrounding structures, and the whole of the affected area is conspicuous by its deficient vascularity.'¹

These minute grey granulations are often aggregated together into larger masses, and then, though the granulations themselves are essentially non-vascular, vessels may be found in the interstices of the aggregate mass which belong to tissues interposed between the component parts of the mass. The

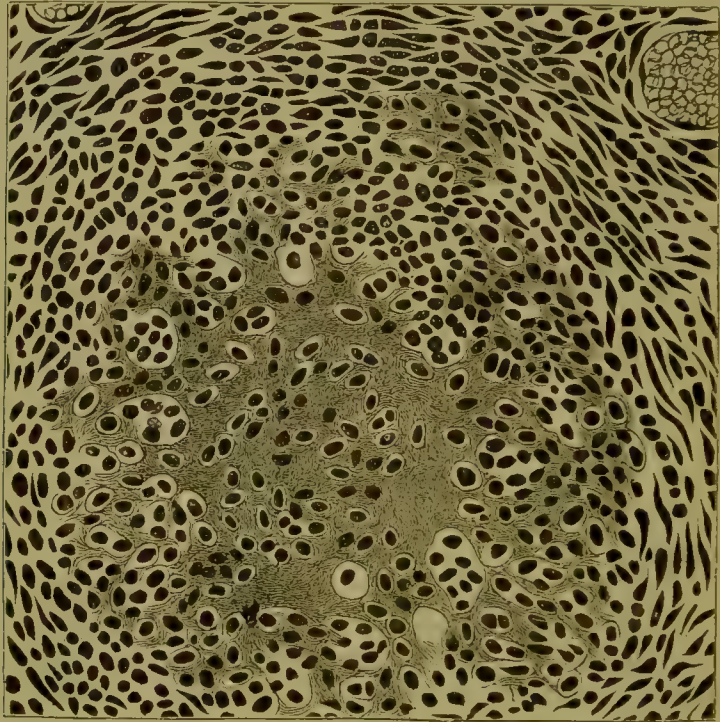


FIG. 181. Miliary tubercle. A magnified view of one of the 'grey granulations' from a case of tubercular disease of the synovial membrane. By Dr. S. Delépine.

deposit of miliary tubercle is peculiarly apt to follow the course of the small arteries and capillaries, and seems first to occur in the 'adventitia,' or fibrous envelope of the vessels.² Such vessels are, however, according to Cornil and Ranvier, always impermeable, their cavity being filled with granular fibrine mixed with white blood-globules. The presence of the white corpuscles, according to these observers, testifies to the gradual progress of the obliteration. This aggregate of tubercle softens into a yellow caseous substance, and in that condition forms the *yellow* or *crude* tubercle.³ Besides the cells figured above as typical of tubercle, all sorts of débris are met with in micro-

¹ 'Syst. of Surg.' 3rd ed. vol. i. p. 217.

² See Rindfleisch, *op. cit.* p. 137; Wilson Fox, 'On the Artificial Production of Tubercle'; and Mr. Treves's essay, where beautiful representations of its microscopic structure will be found.

³ Characteristic illustrations of the naked-eye appearance of crude tubercle will be found in the chapter on DISEASES OF THE BONES.

scopical examination—‘ill-formed epithelial cells, masses of pigment, crystals and plates of cholesterine, remnants of enclosed and disintegrating tissue’ (Savory). Latterly the existence of a special and characteristic bacillus in tubercle, which had been previously asserted by other microscopists, has been reaffirmed by Koch, and supported by a demonstration through a new staining process. This demonstration has been accepted as conclusive by many competent observers, and Mr. Treves speaks of it as ‘apparently unanswerable.’ The bacillus is a rod-like body, measuring one-quarter to one-half the diameter of a red blood globule, and its breadth is about one-fifth of its length. Some of them present bright oval dots, which are believed to be spores. They can be demonstrated by staining with aniline dyes, and are principally found in the giant cells of recent tubercle.

As the yellow tubercle degenerates it undergoes one of the two forms of metamorphosis. In most cases it softens and breaks down, and in this degeneration the tissues around are involved. They become disintegrated by low inflammation, and thus a strumous abscess, vomica, or strumous ulcer is formed. It seems that this softening may either commence in the centre of the tubercle, and thence gradually spread to the tissues, or else the inflammation of the latter may involve the destruction of the tubercle. In other cases the tubercles harden as they degenerate, the fluid parts are absorbed, leaving a hard, chalky mass, the cretaceous tubercle, and this change may affect the grey granulation as well as the crude tubercle.¹ In this condition the withered, dried-up mass generally remains innocuous, though sometimes, as Sir J. Paget points out, renewed suppuration is set up around it (‘residual abscess’), and thus it is cast out.

Two forms of struma are spoken of both by Mr. Savory and by Sir W. Jenner. The former speaks thus of the two forms: ‘In the first, distinguished as the sanguine or serous, there is a general want of muscular development; for, although the figure may be sometimes plump and full, the limbs are soft and flabby; the skin is fair and thin, showing the blue veins beneath it; the features are very delicate; often a brilliant transparent rosy colour of the cheeks contrasts strongly and strikingly with the surrounding pallor; the eyes, grey or blue, are large and humid, with sluggish pupils, sheltered by long silken lashes; hair fine, blonde, auburn, or red; teeth white, and often brittle; there is frequently a fulness of the upper lip and alæ nasi; the ends of the fingers are commonly broad, with convex nails bent over their extremities. Such persons usually possess much energy and sensibility, with elasticity and buoyancy of spirits; they often possess, too, considerable beauty. In this variety, with the same delicacy, the skin and eyes are sometimes dark.

‘In the second, distinguished as the phlegmatic or melancholic, the skin, pale or dark, is thick, muddy, and often harsh; the general aspect dull and heavy; hair dark and coarse; the mind is often, but not always, slow and sluggish.

‘Children especially, in whom the diathesis is strongly marked, are often distinguished by the narrow and prominent chest, the tumid and prominent abdomen, and the pastelike complexion; the limbs are wasted; the circulation languid; chilblains are common on the extremities; the mucous membranes particularly, and above all of them the digestive, are liable to morbid action; the breath is often sour and fœtid; the tongue is furred, and the papillæ towards the apex red and prominent; the bowels act irregularly, and the evacuations

¹ Rokitansky, who regarded the two kinds of tubercle as independent, speaks of this as the only metamorphosis which the grey granulation undergoes.

are unusually offensive; the digestion weak, the appetite variable and capricious. In Dr. Todd's opinion, "the strumous dyspepsia presents a more characteristic feature of this habit of the body than any physiognomical portrait which has yet been drawn of it." The relation of the digestive organs—the subject upon which Abernethy was so wont to insist—to scrofula was, many years ago, particularly dwelt upon by Lloyd. There is often a strong assumption of age both in character and appearance—in mind and manners they are prematurely old.

'Moreover, persons, and especially children, possessing this diathesis are very subject to certain affections which are regarded by many as manifestations of scrofula; such, for instance, as various eruptions, frequently seen behind the ears; chronic inflammation of the eyelids and conjunctivæ; a certain form of ophthalmia, described as strumous; chronic ulcers of the cornea, &c.'¹

Causes.

The causes of scrofula may be considered under two heads: predisposing causes, and exciting causes.

By the predisposing causes we mean those general conditions of the system which favour the development and growth of tubercle. And it is undoubtedly true that hereditary predisposition plays a very great part in the production of a condition favourable to the development of this disease. Parents who suffer from, or have suffered from, scrofula or tuberculosis beget children who are liable to show manifestations of scrofula or tuberculosis. It is also indubitable that scrofula may be predisposed to by any permanent source of malnutrition, such as bad air, overcrowding and ill-ventilation, insufficient clothing, bad or scanty food, or insalubrious climate.

The exciting cause of scrofula is anything which weakens or impairs the nutrition of a part, and this serves to localise what cannot but be regarded as a general disease. One of the most potent of these causes is local injury. This has been proved by the experiments of Schüller above referred to, in which he induced scrofula by contusing joints in animals which had been caused to inhale tubercular matter. And it must be in the experience of every one that some scrofulous affection—say, scrofulous disease of a joint—has been excited and set up by some slight injury, the effects of which in a healthy individual would have passed off in a few days and left no ulterior evil consequences. Another frequent excitor of some scrofulous disease is chronic inflammation. This may be seen in many cases of scrofulous disease of the glands, induced by some chronic inflammation in the parts in the neighbourhood, which pour their lymph into the vessels passing to these glands. This lymph is somehow or another vitiated by being derived from a diseased part, and, being carried to the gland, causes an inflammation which, in a subject predisposed to scrofula, assumes a scrofulous type.

Treatment.

The treatment of scrofula must consist, in the first instance, in endeavouring to prevent any full manifestation of the disease in those who present any predisposition to it. We cannot act upon the hereditary predisposition further than by enforcing increased caution in the management of such children and young persons as are clearly under its influence, so as to withdraw them as far as may be possible from all the agencies by which the diathesis may be subsequently acquired. When the disease is once developed every condition which can improve the patient's general health must, as far as possible, be secured. Fresh air, moderate exercise, the free action of the skin and bowels, an equable and temperate climate, residence by the seaside, a light, nutritious, unstimulating diet, are, as a general rule, of more importance

¹ 'Syst. of Surg.,' 3rd ed. vol. i. p. 363.

than medicines, and routine practice is as bad in strumous as in other cases. But there can be no question of the great advantages which are obtained by the judicious administration of cod-liver oil in cases accompanied by emaciation without much dyspepsia, of iron in those where anæmia is a prominent feature, of the syrup of the iodide of iron where the patient is weak, fat, pale, and flabby; of bark and mineral acids in cases where hectic is present; of alkalies in combination with sarsaparilla or milk, along with the moderate use of purgatives, where the secretions are disordered and the digestion faulty. Of these, by far the most important agent in the treatment of scrofula is cod-liver oil; and, although there is no space in this work for details which more fitly belong to a treatise on therapeutics, yet I must state the most necessary precautions in the use of this drug. The chief objection to its use is the nausea which it produces, especially at first. This is much diminished by commencing with small doses, and by giving the oil on a full stomach—about a quarter of an hour after meals. The full dose for a child would be about two teaspoonfuls, and a tablespoonful for an adult. The taste may be very successfully disguised by floating the oil on orange-wine or tincture of orange, or steel wine; or by mixing it with five or six drops of liq. strychniæ, or a little mineral acid. Often, if the patient can be induced to persevere, his repugnance to the oil will wear off; and as the oil will have to be taken for many months, if it agrees, it is well worth some trouble to establish this tolerance. After a time patients, and particularly children, can take it as an ordinary article of diet, not only without disgust but with pleasure.

The local treatment of scrofula consists in a great part in the ordinary treatment of chronic inflammation. These diseases are essentially chronic maladies, and the great majority of them can usually be brought to a successful issue by laying open any suppurating cavities, scraping away any caseous matter, and adopting antiseptic treatment. Iodoform is especially useful in these cases. When there is prolonged suppuration, and this, conjoined with enforced deprivation of air and exercise, is breaking down the health, or when extensive disease of the bony or other structure of the part holds out no hope of natural cure in any reasonable time, the removal of the affected organ by excision or amputation is indicated; and I think that I have had abundant experience even in my own practice to show that such operations are usually followed by complete and permanent recovery in cases which would by every one be classed as strumous.¹

Scrofula is generally a disease of youth; but similar symptoms appear sometimes after middle age, and have lately been more especially described by Sir J. Paget ('Clinical Lectures,' 1875) as 'senile scrofula.' The disease at this age holds out little prospect of cure, but the general indications of treatment are the same.

¹ See a paper in the 'Lancet,' Feb. 24, 1866, on 'The Sequel in some Cases of Excision and Amputation.'

CHAPTER XIX.

HYSTERIA AND NERVOUS DISEASES.

Definition
and patho-
logy of
hysteria.

HYSTERIA is a disease which it is very difficult to speak of intelligibly and adequately within the compass of a work like this. Yet, as there is no disease which it does not sometimes simulate, and as the diagnosis between real or, to speak more correctly, organic disease and hysterical or nervous affection is of daily importance and of the greatest difficulty in some of the most common surgical complaints, notably those of the spine and joints, it is a condition which cannot be passed over unnoticed in any systematic treatise on surgery. Besides the general remarks in this chapter the reader will find observations on the various special affections in other parts of the book—especially in the chapters on diseases of the JOINTS, the SPINE, and the BREAST.

I have just said that it is more accurate to speak of hysterical disease of a part as contrasted with 'organic' than with 'real' disease; and this is very important. Hysteria is sometimes spoken of as if it were unreal—a mere fancy—perhaps a mere simulation. Such a view is most erroneous, and practice founded on it cannot be successful. The structure of the part is not as a rule in any visible or tangible way affected (though to this rule some exceptions will be pointed out), and there is no danger to life or limb; yet it is impossible to doubt that in many, and I would say most cases, the sensations are as real as those of any other disease, and the patient as anxious to be rid of it as of any other disease. The cause of the disease may be imperceptible to our senses; but it is none the less really present, and its effect is as real as any tumour or other visible product.

Perhaps the best definition of hysteria would be that it is a morbid state in which various symptoms are produced, depending, not on disease of the part affected, but on some condition of the central nervous organs. At the time when the disease was named, it was supposed that this condition of the cerebro-spinal centre was excited by uterine disturbances, and doubtless such disturbances are a frequent exciting cause; but the disease may exist in women whose uterine functions are perfectly normal, and even (though not so often) in men. In these latter cases the origin of the hysterical disturbance is obscure; and in the case of disordered uterine functions, though the cause may be plain enough, its mode of action is utterly unknown.

Hysteria differs from mere delusion, hypochondriasis, or fictitious disease, in the fact that the morbid sensations or other symptoms are due to a really existing physical cause—though it is remote from the part affected, and though its detection may be difficult; but it must be allowed that much of delusion and hypochondriacal exaggeration is mixed up with almost all cases of hysteria, and that in many of them the patient wilfully exaggerates many of the symptoms, and very likely feigns others. So that there is a mixture of mental and physical causes in the disease, and its cure must be attempted by treatment addressed to the mind as well as to the body.

Sir James Paget, in a striking series of lectures on this subject,¹ wishes to abolish the old term 'hysteria' altogether, or at least to restrict it to the

'Nervous
mimicry,'
or 'Neuro-
mimesis.'

¹ 'Clinical Lectures,' pp. 172 et seq.

mere hysterical convulsive affection. The great class of diseases usually spoken of as hysterical he would call 'neuro-mimetic,' or 'nervous mimicries' of the diseases of the various organs. As a general rule he denies that such diseases have any more connection with the sexual than with any other system of organs in the body. 'In the defective ovarian or uterine functions of certain patients,' he says, 'some see the centre and chief substance of the whole disease; a very mischievous fallacy. Of course the sexual organs appear generally in fault to those who are rarely consulted for the diseases of any other part; but in general practice they are, in a large majority of cases, as healthy as any other parts are, or not more disturbed. The close and multifiform relations of the sexual organs with the mind, and with all parts of the nervous system, are enough to make the disorders of these organs dominant in a disorderly nervous constitution; but their relation to 'hysteria,' or to 'neuro-mimesis,' though more intense, is only the same in kind as that of an injured joint or an irritable stomach. All, in their degrees, may be disturbers of a too perturbable nervous system, and equally on every one of them the turbulence of a nervous centre may be directed with undivided force' (op. cit. p. 191).

In fact, nervous or hysterical disease may be excited by anything which makes a strong impression on the nervous system: whether it be sexual disturbance, imagination, bodily injury, mental affection, intense emotion, or any form of disease.

The usual manifestations of hysteria are the hysterical fit, the globus hystericus, the clavus hystericus, and the diseases resembling those of various organs.

Symptoms
and
diagnosis.

The hysterical fit may be taken as a simulation of epilepsy, though it is usually distinguished from it by characters too obvious to allow of any mistake. It begins generally with rising in the throat, a sense of choking, followed by wild, convulsive movements, or rather semi-voluntary movements resembling convulsions, with partial, or sometimes complete, loss of consciousness, flushed face, eye unusually sensitive to light, the fit ending generally in crying, screaming, and laughing. This is followed by a copious flow of pale urine, very often tympanitis, and generally by profound sleep. Sometimes one fit, or a succession of fits, may last for several hours.

The diagnosis and treatment of hysterical fits is more within the province of the physician than the surgeon. The imperfect insensibility, the absence of any obstruction to respiration, the age and sex of the patient (for true fits hardly ever occur in male hysteria), are the main distinctive marks.¹ No treatment should, as a general rule, be adopted, beyond seeing that the patient does herself no harm by her movements, and limiting the officiousness of bystanders. The rough awakening of a cold douche or some other similar shock is often effective enough in dispelling the fit, and it may occasionally be advisable to use such measures; but ordinarily they do more harm than good.

The globus hystericus is the sensation of some weight or substance which rises from the abdomen into the throat, and this sensation is often followed by the choking and other phenomena of a fit of hysterics. The 'clavus,' or hysterical headache, is a feeling as if a nail were driven into the head. It is a common and troublesome but subordinate feature in the general disease.

The main point, however, in practical surgery is to distinguish those

¹ There are, however, cases in which hysteria and epilepsy seem to be mixed together. See Charcot on 'Hystero-epilepsy,' Lect. xiii. 'New Syd. Soc. Trans.'

surgical diseases which are hysterical or nervous from the organic affections of the same organs. The joints, the spine, and the breast are the most frequent seats of hysterical pain and loss of function ;¹ but hysteria may simulate almost any surgical as well as medical disease, and the diagnosis is often rendered the more perplexing by the fact that hysteria very frequently aggravates, and sometimes masks, diseases which really exist ; so that in the former case the surgeon, seeing that there is distinct proof of organic disease, is apt to attribute grave importance to what is really only a trifling complaint, aggravated by hysterical symptoms ; while in the latter case the symptoms of hysteria are so prominent that he overlooks some disease which is really present.

The diagnosis between hysterical and organic affections rests mainly on the following considerations : 1. The pain in hysteria is usually intermitting, irregular, and often much in excess of anything that the visible condition of the parts can account for ; it bears no relation to the duration of the disease, and is often obviously affected by emotional causes, and often by the state of the uterine or digestive functions. It differs from true neuralgia in not being generally periodic and in not following the distribution of any nerve, though in many cases hysterical pain is called neuralgia. 2. The *tenderness* which is almost always complained of is diffused, and is, as it were, *inconsistent*. Thus, for instance, in hysterical disease of the spine the patient will often complain of quite as much pain from a light touch to the skin as from pressure made on the vertebral spines themselves, and it is greatly aggravated by the patient's own attention being directed to it : a patient who, while her attention is fixed on the surgeon's examination, cannot bear the slightest touch on the back without complaining of acute pain, will often be hardly sensible of firm pressure if made at a moment when she is eagerly talking of something else. The *course* of the disease is, however, one of the main elements in the diagnosis, and perhaps of all others the most satisfactory in cases which are otherwise somewhat obscure. We have only too often opportunities of seeing poor women who from unfortunate errors in the diagnosis have been condemned to years of total inactivity for supposed spinal or articular diseases ; yet no abscess, no deformity, no material alteration in the shape of the parts has resulted,² still less any of the formidable consequences which inflammation would have produced on the parts in the neighbourhood. It is, however, noticed, and not indeed very rarely, that there is some tumefaction round the seat of the disease, often the result, as Sir B. Brodie tells us, of local applications,³ but also present, I think, in some cases where no friction or blistering has been employed, and then probably the result of congestion. The cause which produces such congestion is, no doubt, the pain ; for the pain in hysterical disease is often (as I have said above) as real as any other pain, and pain easily affects the supply of blood to the part, just as in periodical neuralgia the pulsations of small and previously invisible arteries become plainly perceptible before and during the paroxysm. Sir B. Brodie has noticed that in some hysterical affections of the joints there is a periodical change of temperature, not only of the part but of the whole limb, and he dwells on the value of quinine in such cases (Works, vol. ii. pp. 308, 309).

¹ Sir B. Brodie says that 'among the higher classes of society at least four-fifths of the female patients who are commonly supposed to labour under disease of the joints labour under hysteria and nothing else.' Sir B. Brodie's Collected Works, vol. iii. p. 157.

² Sir J. Paget gives some striking instances of the perfectly healthy condition of joints after prolonged disuse (op. cit. p. 206).

³ Op. cit. p. 159.

These cases mark still more plainly the affinity between hysteria and neuralgia.

Sir J. Paget has also pointed out the extraordinary variations in *temperature* which sometimes occur in 'nervous' maladies. As a general rule the temperature is an important fact in the diagnosis of hysterical affections, since it is far nearer the normal than it would be if the disease were organic; or, if it varies, the variations are limited, and probably periodic. But these excitable and nervous patients are liable to great disturbances of temperature from slight causes; so that Sir J. Paget says of the temperature, that though 'prudently estimated, it is of the highest value even in nervous patients; over-estimated, it is more fallacious in them than in any others.'

Temperature in hysteria.

These are the chief features in the diagnosis of hysterical affections from their local symptoms. Next the surgeon has to weigh carefully the general symptoms which the patient presents. The complexion of the patient's mind must be studied. The extensive experience of Sir J. Paget has taught him that 'nothing can be more mischievous than a belief that mimicry of organic disease is to be found only or chiefly in the silly selfish girls among whom it is commonly supposed that hysteria is rife, or almost a natural state.' He believes it to be more true to say that these nervous diseases are seldom to be found in 'patients who have ordinary minds—such minds as we may think average, level, and evenly balanced'—but that in the majority of patients of this class 'there is something notable, bad or good, higher or lower, than the average.' Any observations, however, which may thus be made on the patient's mental constitution can amount to nothing more than a probability, and that not of a very high degree. More tangible evidence may be obtained from the patient's family history—many of the worst instances of hysteria occur in girls brought up by mothers themselves hysterical; from the circumstances of the case—many nervous diseases springing from the contemplation of cases occurring in the family or in public; and from the strange possession which such diseases take of the patient's mind and will.

General character of hysterical patients

With the best attention the surgeon can give to the case, it must be allowed that the diagnosis is often a very doubtful one; and in order to justify a confident opinion in any but the plainest cases, repeated examination and observation are essential.

Nothing can be more difficult than the treatment or management of some of these hysterical affections. Too much attention on the part of the surgeon fixes the patient's mind on her ailment, increases its apparent importance in her eyes, and in many cases certainly tends to protract it; on the other hand, roughness or neglect loses her confidence, without which all treatment is nugatory. The moral treatment of hysterical affections is of as much importance as the medical, or more. The first point is to convince the patient that the disease is understood and its real importance admitted, though not exaggerated. For we must allow that hysteria, though not dangerous to life, and seldom threatening the reason, is a very grave disease, and often entails lifelong misery on its victim. When, however, the patient is relieved from the worst anxieties, such as the fear of permanent paralysis, lameness, or other organic disease, the medical or surgical treatment of the case becomes easier. I can hardly do better than transcribe Sir B. Brodie's excellent remarks on the treatment of hysterical joint-affections:—

Treatment.

'The recovery of patients labouring under these hysterical affections is often tedious. But much depends on the treatment, moral as well as physical. The sulphate of quinine, preparations of iron, the citrate of quinine

and iron, may generally be exhibited with advantage ; and these may, according to circumstances, be combined with ammonia or the ammoniated tincture of valerian. In most instances the bowels are in a very torpid state, and active purgatives are from time to time required. The air of the country, and especially that of the sea-coast, is more favourable to the patient than that of a large town, and while at the seaside she may use cold sea-bathing with advantage, during the summer and early part of the autumn. However, as to constitutional treatment, the best rule that can be laid down is, that the medical attendant should inquire into the state of the general health, and prescribe for the patient according to the circumstances of each individual case. If the menstruation be irregular, deficient, or excessive, he should make it an especial object to restore this function to a healthy condition. . . . To a considerable extent these cases admit of being benefited by medical and surgical treatment ; but what I have termed the moral treatment of them is of still greater importance. If a young lady who is thus afflicted be confined to her sofa, her attention being constantly directed to her complaint by the anxious inquiries of her friends, the daily visits of her medical attendant, and the exhibition of a variety of drugs, the symptoms may continue unaltered for many months, and even (and that is by no means an unusual occurrence) for several years. The very opposite course to this should be pursued. Her attention should be as much as possible directed to other objects. She should enter into the society and join the pursuits of persons of her own age. She should be encouraged to use the limb, even though the attempt to do so gives her pain in the first instance ; and she should pass a portion of each day in the open air. Under this mode of treatment I have known many cures to be obtained without any medical or surgical treatment whatever.'¹ Sir Benjamin also gives some directions for the local treatment, as applicable to hysterical affections of joints. Such treatment must, of course, vary for different organs. Its general principle is to do as little as possible to fix the patient's attention on the part. Any plaister, bandage, or other application which keeps the part comfortably warm and prevents the patient from handling or looking at it, may do good. Sometimes pain suddenly inflicted, as by the moxa or a galvanic shock, effects a wonderful cure—similar to Sir B. Brodie's case, in which a young lady was cured of an hysterical pain in the hip by a fall from a donkey. And there are cases (as he also mentions) in which a sudden mental impression, such as a sudden call to 'rise up and walk,' has produced the desired result. But as a general rule little is required in the way of local applications beyond what is necessary to maintain the natural warmth of the part. Warm bathing is often of much service : and so is galvanism if properly applied. Cold, Sir J. Paget says, almost always does harm.

Narcotics and opiates are to be avoided by all means if possible. They are generally unnecessary, and often most injurious, and should only be used when it is impossible to avoid it ; and this impossibility should not be hastily admitted. I have often known patients habituated to the use of opium for nervous pain who could by no means sleep without pills, but who slept quite as well when they were made of bread as of opium. At the same time the patients must have quiet sleep : and although exercise is to be enforced, yet long periods of rest afterwards are needed.

¹ Sir B. Brodie's Works, vol. ii. p. 309.

CHAPTER XX.

VENEREAL DISEASES.

FORMERLY all diseases which owed their origin to contamination from impure sexual intercourse, even gonorrhœa, were classed together as syphilis. Then the term came to be applied to those cases in which a local sore was produced as the result of the inoculation of some *materies morbi*, and gonorrhœa was excluded. In modern surgical language the term is further restricted to a constitutional disease, and to such primary sores as are followed by infection of the system.

Under the head of *VENEREAL DISEASE* we shall have to consider :

1. Gonorrhœa. 2. Local soft sore. 3. Syphilis.

Gonorrhœa is a specific inflammation of the mucous membrane of the male urethra or of the female genitals, believed to be due to the inoculation of a micro-organism, the *gonococcus*. It differs widely in the two sexes. It is so much slighter a disease in women that the descriptions of it are always taken from the male sex. Four stages of the complaint are described—the premonitory, the inflammatory, the stage of decline, and that of gleet.

Gonorrhœa
in the
male.

The first lasts often only a few hours, sometimes as much as two days, and commences generally from two to five days after intercourse—rarely later. It is marked by a slight itching and a little tumefaction of the lips of the meatus, and possibly some slight discharge, just enough to make the lips of the urethra stick together.

The pre-
monitory
stage.

This is succeeded by the second stage, in which there is high inflammation of the lips of the urethra, and sometimes also of the prepuce, causing phimosis, with creamy, greenish, purulent discharge, tenderness to pressure along the urethra, scalding in making water, which is sometimes so painful as to occasion much spasm and difficulty in doing so, even temporary retention; a sensation of weight in the perinæum, and painful erections, especially at night. Sometimes *chordee* is present, i.e. an effusion of lymph into the corpus spongiosum, which prevents distension of its cells in erection, causing the distended corpora cavernosa to bend over it, and thus giving the organ a curved shape as if bound down by a cord. This, however, is rare by comparison with the occurrence of mere painful erections, and still rarer are the cases in which the effusion takes place into the corpus cavernosum, causing the penis to curve to one side in erection.

The in-
flammatory
stage.

The inflammatory stage lasts from one to three weeks. Its symptoms are due to acute inflammation, and sometimes ulceration of the mucous membrane lining the urethra, usually situated around the fossa navicularis and in or about the bulb,¹ though it seems that any part or the whole of the canal may be affected.

The third stage (which is, in fact, a part of the second) is marked by the recession of all the symptoms, the scalding subsiding, the discharge becoming more and more mucous, and the disease then either disappearing altogether or passing into the fourth stage, that of *gleet*, which is a mere thin, watery discharge, unaccompanied by any symptoms except, perhaps, a little tender-

The stage
of decline.

Gleet.

¹ See a preparation in St. George's Hospital Museum, Ser. xii. No. 61.

ness to pressure over the affected part of the urethra, the discharge proceeding from localised inflammation, or, as some think, probably ulceration of the mucous lining of the fossa navicularis, or bulb.

The common complications of gonorrhœa are as follows :—

Complica-
tions of
gonorrhœa.
Lacunar
abscess.

Abscess may form in the areolar tissue of the penis or scrotum ; or, as is much more common, in one of the lacunæ of the urethra. Such ‘ lacunar abscess ’ also occurs from other causes, as from riding on a wet saddle or inflammation behind a stricture. It forms a small, hard, painful swelling in the course of the urethra, which often occasions considerable difficulty in micturition, amounting even to complete retention. For its treatment it is usually sufficient to apply a poultice and pass a catheter when necessary to relieve retention, in doing which the abscess is often ruptured and the complication disappears. If there is much pain there can be no objection to making a puncture. The abscess bursts generally into the urethra ; if through the skin, fistula hardly ever results, for the opening into the urethra either does not exist or closes spontaneously.

Balanitis.

Balanitis is less a complication than a form of gonorrhœa. We have noticed that in ordinary gonorrhœa the prepuce may be so much swollen as to cause phimosis. Sometimes this inflammation and swelling of the prepuce and the surface of the glans is the whole of the disease, the interior of the urethra being unaffected, or only its lips inflamed. The absence of scalding in making water will lead the surgeon to the belief that he has a case of pure balanitis to deal with, but he can hardly be certain until the inflammation of the prepuce has subsided sufficiently to allow of the examination of the meatus.

Phimosis.

Again, inflammation of the prepuce leading to phimosis is so common with chancres, that often cases which have been diagnosed as balanitis turn out to be due to this cause. Hence a good deal of reserve in forming and expressing an opinion is desirable. Cases of veritable balanitis are to be treated by keeping the penis raised and washing out the prepuce frequently with injections of cold water or some astringent, as lime-water or weak solution of nitrate of silver. The parts may be dusted at night with calomel in fine powder mixed with magnesia, to be washed away with the injection in the morning. The mere phimosis produced in ordinary cases by gonorrhœa seldom requires any operation, as it will subside on the recession of the disease ; but in cases of gonorrhœa affecting persons who have congenital phimosis it is often necessary to operate.

Paraphi-
mosis.

Paraphimosis is a much more painful affection than phimosis, of which it is a sequel. The phimosed and inflamed prepuce has been forcibly drawn behind the corona glandis, and has there swelled and inflamed still more, producing great constriction and consequent swelling of the glans, with grievous pain ; and, if unrelieved, leading to ulceration where the penis is constricted by the prepuce, and to more or less extensive gangrene of the constricted glans penis. A paraphimosis can generally be reduced if seen before adhesion has taken place between the constricting prepuce and the tissues beneath. The fore and middle fingers of the two hands should be crossed on each other around the penis, which is thus firmly grasped, and the prepuce pulled forwards, while with the two thumbs the blood is kneaded out of the glans and the latter pushed back. As this is acutely painful, it is usual to administer an anæsthetic. If the paraphimosis be irreducible, the strangulation must be liberated by cutting freely through the constricted prepuce on either side of the penis, so as neither to endanger the vessels on the dorsum

nor the urethra on the lower surface of the organ. After all swelling has subsided the prepuce, if too long, must be circumcised.

Another complication of gonorrhœa is severe spasm in making water, sometimes complicated with hæmorrhage from the urethra, and then very probably depending on ulceration of the lining membrane. This is more annoying and alarming to the patient than really dangerous. The spasms will subside by very free use of the warm hipbath (in which the patient can generally pass water easily) and by rest, abstinence from any irritating medicines or applications, bland drinks, and opium. The hæmorrhage is never really formidable, but if it is at all copious the acetate of lead or Ruspini's styptic may be given internally, and the patient kept in bed, with ice applied to the perinæum. The hæmorrhage occurs most frequently in connection with chordee, and the treatment which obviates the latter condition will stop it. The most effectual treatment for chordee is to procure very sound sleep, by means of bromide of potassium and opium taken immediately before going to bed, or a suppository of ten grains of camphor and one grain of watery extract of opium may be administered. The patient should also be kept slightly below par by low diet and small doses of tartar emetic.

Spasms and hæmaturia.

Chordee.

Bubo is a common complication, and sometimes the lymphatics of the penis are themselves inflamed and stiffened, whereby a difficulty in erection is produced something like chordee. In these cases mercurial ointment in small quantities should be rubbed in. The inflamed inguinal glands should be treated at first by complete rest, and then, if hard and indolent, by tinct. of iodine, or by blistering. The latter is an excellent remedy in chronic bubo, frequently procuring the absorption of the swelling, and when it does not do so, usually causing it to suppurate. When suppuration is decided the abscess should be laid open pretty freely. Some surgeons lay great stress on making the opening perpendicular instead of parallel to Poupart's ligament, thinking that the movements of the thigh and body will have less tendency to keep the wound open. I cannot say, however, that I attach much importance to the direction of the incision, provided it passes pretty completely through the cavity.

Bubo.

Gonorrhœa is sometimes followed by an eruption of red papules. This is usually the consequence of the administration of capivi to a patient whose stomach will not bear it, and is hence called the 'capivi rash'; but a similar rash may also, though rarely, be found when gonorrhœa is complicated with other forms of gastric irritation not caused by capivi. The eruption, being papular, resembles lichen more than any other form of skin-disease, but sometimes it is merely a rash, like roseola. In other cases it is mixed with wheals of urticaria. The treatment consists in leaving off capivi or anything else which may be disagreeing with the stomach, free purging, and the correction of the secretions by alkalies with mercury.

Gonorrhœal and capivi rash.

Gonorrhœal rheumatism, or synovitis, is a painful and often a very intractable disease. Its pathology is still a matter of dispute; but there seems now a very general agreement that it depends in some way or other on the irritation and discharge in the urethra, and that its cure must be sought for in the cure of the urethral discharge; and this lends at any rate considerable probability to Mr. Barwell's¹ speculation that the disease may really be a form of pyæmia or blood-poisoning, the starting-point of which is inflammation of the veins around the urethra or prostate gland. It is often noticed that the inflammation will persist so long as the discharge persists, and even so long

Gonorrhœal rheumatism.

¹ 'On Diseases of the Joints,' 1861, p. 101.

as there is any tenderness in the affected portion of the urethra, but subsides at once when the urethra has become perfectly healthy. Such rheumatism is not confined entirely to gonorrhœal inflammation of the urethra, but is sometimes, though rarely, found after urethritis from other causes.¹ It is far rarer in women than men, and this corresponds with the general immunity of the female urethra in gonorrhœa, though cases of gonorrhœal rheumatism have been recorded in females. It almost always affects the knee; other joints may also be implicated, but I can hardly recollect a case in which the knee was not the principal seat of the disease. The pain is not usually acute but it is constant, worse at night, and accompanied by considerable synovial effusion. This form of rheumatism is often followed by ankylosis.

'There is also,' says Mr. Bond, 'a most common and characteristic complication affecting the eyes, and this is a congestion of the sclerotic. The conjunctiva is sometimes slightly congested, and the carunculæ red and injected; but the great peculiarity is the congestion of the sclerotic vessels which are seen radiating around the cornea.'

Treatment
of gonor-
rhœal rheu-
matism.

The patients are usually pale anæmic men, in whom discharges are very liable to occur and very difficult to cure; and the connection of the rheumatism with the gleet is sometimes conclusively proved by the recurrence of the former when any accidental cause (of which the most frequent is sexual intercourse) has produced a renewal of the latter.

Accordingly the first indication of treatment is to cure the discharge. If a bougie or catheter be passed it will almost always be found that there is considerable spasm; and that the urethra bleeds very readily. Under the influence of instruments gradually increasing in size the irritability of the urethra will often subside and the gleet disappear. If not, astringent and sedative injections must be resorted to. The general health must be carefully attended to; steel, quinine, strychnia, bark, or any other tonic which may be preferred, must be administered, with good diet and a sufficient supply of stimulants. At the same time the digestion and the state of the urine must be carefully attended to.

Iodide of potassium is often administered in this disease, and when the patient is in robust health and the drug agrees with him I have seen very good results from it; but I agree with Mr. Bond in dissuading its employment in cachectic persons.

Locally, some mild counter-irritant generally answers best, combined with gentle pressure when the pain has subsided. Scott's bandage is a very good application in the last stages of the complaint. In a case recently under my care, in which the effusion was considerable and the symptoms unusually severe, I emptied the joint by means of the aspirator, with excellent results.

Other com-
plications.

The other complications of gonorrhœa are inflammation and abscess of the prostate, orchitis, or epididymitis, and gonorrhœal ophthalmia. These will be found treated of in the chapters on diseases of the URINARY ORGANS, of the TESTICLE, and of the EYE respectively.

Treatment
of gonor-
rhœa.

The treatment of gonorrhœa is often very difficult, and the more so the more virulent is the affection and the more cachectic the patient. With regard to the former particular, there can be no doubt that inflammation of the male urethra follows sexual intercourse with women who have no specific disease, but who are suffering from leucorrhœa, or who have some ulceration

¹ Hence it is sometimes called 'urethral rheumatism.' See a very interesting paper by Mr. Bond, 'Lancet,' March 23, 1872.

of the os uteri, or who are menstruating ;¹ but such affections, if they deserve the name of gonorrhœa, are far less acute under ordinary circumstances than the disease which is excited by true gonorrhœal pus, and they come on with less premonitory symptoms.

In the early stage gonorrhœa may doubtless be often cut short by repeated injections, for which purpose either mere water may be used, cold or tepid, or a weak solution of acetate of lead or sulphate of zinc, the object being merely to wash out the discharge. The patient must be carefully instructed in the method of injecting, and the process be repeated every hour while he is awake.

At the same time demulcent drinks, low diet, slight purging, and complete rest, in bed if possible, are to be ordered.

Some practitioners use stronger injections, such as arg. nit. in solution, but they are more dangerous and not more efficient. The first effect of these strong injections is to increase the inflammation, so that after about two days there will be a good deal of discharge, and perhaps a little blood. Then the injection is to be stopped, in the hope that the discharge will subside and the patient recover under the same precautions about rest and diet as before.

In the inflammatory stage the treatment should not, certainly at first, be too active. The patient seems to me to recover more speedily if treated at first by demulcents, rest, frequent warm bathing, warmth or poultices to the perinæum, with leeches there if the symptoms be very urgent, and low diet with much bland fluid, than where any specific medicines are ordered. Injections other than those of tepid water should not be used while there is much scalding and inflammation. The meatus must be kept clean by frequent ablutions, and the penis should not be too closely covered. When the acute symptoms are subsiding copaiba is often most useful, and in some cases indispensable to the cure of the disease. I have known cases in which the discharge would at once recur when the drug was omitted, though in other respects the treatment and all other circumstances were the same. But there are cases in which it does no good, and some in which it does much harm, upsetting the digestion, causing rash, and probably irritating the urethra, and so predisposing to gleet and other complications. It is best prescribed either in the form of an emulsion, or in doses of ʒss. or ʒj., mixed with mxxv. of dilute sulphuric acid in infusion of roses. The common capsules disguise the taste of the drug, and are in that respect most convenient ; but they are not so much to be relied upon. Cubebs appears to be much less efficacious, and, indeed, by itself nearly inert as far as the cure of the disease goes ; but some practitioners think that an addition of about ten drops of the tincture of cubebs increases the efficacy of the copaiba.² Oil of sandal-wood may sometimes be prescribed with advantage, but its action is uncertain.

¹ It is on this account that it is commonly said that gonorrhœa is more frequent in men than in women.

² The treatment of gonorrhœa in private or hospital out-patient practice is necessarily somewhat unsatisfactory, since it is hardly possible to insist on the complete rest and abstinence from all forms of excitement which are so necessary to rapid recovery. In civil hospitals persons affected with gonorrhœa are seldom admitted as in-patients. But in military hospitals the disease is constantly under treatment, and cure is, as a rule, speedily and easily obtained. I accordingly requested my friend Mr. E. Venning, then Assist.-Surgeon to the 1st Life Guards, to sketch out for me the plan which he usually adopted, and which may be taken as agreeing in the main with that followed in other regimental hospitals. Mr. Venning speaks as follows : ' In slight cases, in which the urethral discharge is not very profuse and there is not great inflammatory action present, I simply give the patient a warm bath, and have him placed in bed, and keep him in the

Mr. Watson-Cheyne maintains that the primary point to be aimed at is the destruction of the specific cause of the disease. He therefore recommends that a bougie composed of five grains of iodoform, ten minims of oil of eucalyptus, and a sufficient quantity of vaseline should be introduced into the urethra and allowed to melt there. This should be repeated daily for two or three days, and then an ordinary astringent injection be used.

Treatment
of gleet.

The treatment of gleet is often even more tedious and difficult than that of gonorrhœa. The patient is usually weak, sallow, and cachectic, and depletion does not agree with him. But neither does any copious indulgence in stimulants. Moderate allowances of meat, wine, and exercise are usually to be recommended. Any defect of the general health must be discovered, and as far as may be corrected, and some tonic, such as steel, strychnia, or bark, will generally prove beneficial. Local treatment must be directed in the first instance to discover whether there is any contraction (spasmodic or other) of the urethra; and often the constant passage of bougies, increasing in size until the urethra is distended to its extreme limit, will cure the complaint; or else the use of injections, or touching any tender spot of the urethra with the *porte caustique*, or with a solution of perchloride of iron, will cure the discharge. But often it will not subside till the patient has undergone a thorough change of climate and way of life.

Gonorrhœa
in women.

In females gonorrhœa is a much less severe complaint than in males. It affects chiefly the vulva and vagina, rarely the urethra or bladder. It is difficult or impossible to distinguish aggravated leucorrhœa from mild forms of gonorrhœa; nor is it of much importance, since, doubtless, such leucorrhœa will excite gonorrhœa in the male. Prostitutes are especially liable to leucorrhœa in consequence of the constant excitement of the generative organs; but the certifying surgeons under the Contagious Diseases Acts only think it necessary to seclude those in whom the discharge is purulent. There is a form of purulent discharge from the vulva pretty often seen in young children—the leucorrhœa infantum—which was at one time confounded with gonorrhœa, and was believed to be due to impure connection; but this, in the great majority of cases, is an unfounded suspicion. In some cases, no doubt, young children are affected with ordinary gonorrhœa, but in such instances marks

Leucor-
rhœa in-
fantum.

horizontal position. I generally order a mild purgative to be administered, and direct him to use an injection consisting of *zinci sulph. gr. iv.*, *glycerine ʒss.*, *morph. acetat. gr. ʒ.*, *aquæ destil. ad ʒvj.* To be injected every hour or two, provided no pain is caused. The diet to be light and non-stimulating. In severe cases, where there is much inflammatory action, shown by a profuse, thick, yellow discharge, and accompanied with great urethral irritation during micturition, which latter is generally very frequent, and when chordee causes great distress, I also commence treatment with a warm bath and a brisk purge, and order a saline demulcent mixture (occasionally combining antimony with it) to be given every four hours, and I give directions for the urethra to be constantly washed out with tepid water. In addition to this I order a suppository containing morphia and henbane to be administered at night to relieve the chordee. The diet to be light and non-stimulating. Perfect rest in bed to be maintained. When the most acute symptoms have subsided I then prescribe a mixture containing oil of sandal-wood, mucilage of acacia, and tinct. of orange-peel twice a day, and an injection consisting of *zinci sulpho-carbolat. ʒss.*, *morph. acet. gr. ʒ.*, *aquæ destil. ad ʒviii.* To be used every two hours. If any pain is caused by this, to dilute it with distilled water. If the discharge does not rapidly decrease under this treatment I increase the diet at once, as I have often found that discharge is kept up by the patient becoming lowered in strength by the constant drain on the system; and that the administration of wine in the form of claret, with a generous diet, has been attended with excellent results.'

of violence about the vulva will exist, and will show that forcible entrance has been attempted; or possibly, if the case be seen soon after the rape, spermatozoa may be discovered within the vulva. Usually, however, this discharge originates either from dirt or from some cause difficult to discover. Many of the children certainly suffer from worms. Attention to the general health, strict cleanliness, frequent washing out of the vagina, and the use of a tent steeped in some astringent lotion, will effect a cure.

Gonorrhœa in the female causes acute inflammation of the vagina and vulva, frequently accompanied by swelling of the nymphæ, which protrude beyond the labia. The discharge is sometimes very profuse, and there are often excoriations in various parts of the vagina; the labia are frequently much swollen, and abscess often forms there. Hence there is much pain in walking and in sexual intercourse. Sometimes the inflammation attacks the urethra, and then usually causes more or less cystitis; occasionally it spreads backwards as far as the os or cervix uteri, and it seems certain that peritonitis may be caused by its passage inwards, and that a form of inflammation sometimes attacks the ovary analogous to the orchitis of the other sex. The acuter attacks of gonorrhœa are painful, but there is rarely any scalding in micturition as in men. The complications also are much rarer than in the male. Ovaritis would cause pain, swelling, and tenderness in the iliac fossa, with nausea and fever, and the pain would be aggravated by coughing or other exertion of the abdominal muscles. Rest, free leeching of the abdomen, salines, and opium constitute the appropriate treatment.

Symptoms
of gonor-
rhœa in
females.

Complica-
tions of
gonorrhœa
in the
female.

Bubo is not so common as in males. Its treatment is the same.

Abscess of the labium is the most common complication, and it sometimes extends to a great distance. I once had a patient who was sent into the hospital for supposed fistula in ano. The opening was a good way behind the anus, and on probing it I found that it passed forwards, and then on examination of the vulva the case resolved itself into one of gonorrhœa with labial abscess.

Vegetations and mucous patches around the labia and anus are very common, particularly in prostitutes. Any discharge which may be present being cured, these vegetations will either subside of themselves or may be treated with the strong liquor plumbi, or snipped off, or tied with an elastic ligature. When they are very numerous and large it is better to remove them freely on a level with the skin and apply the actual cautery to any bleeding point.

The treatment of gonorrhœa in the female is very much easier than in the male, provided that the patient is properly under control. In hospital out-patients the disease is often very intractable, because the patient will not take care of herself nor abstain from sexual intercourse; but with perfect rest, perfect cleanliness, and frequent copious injections, the disease will in almost all cases soon subside. The injection, or rather the washing out of the vagina, should be managed by means of large quantities of some weak lotion, such as Goulard, or a solution of sulphate of zinc, two grains to the ounce, pumped in, while the patient is recumbent, by an endless syringe (Evory Kennedy's), and allowed to run out. If any ulceration can be seen it may be touched with caustic through the speculum. Lint steeped in the lotion should be placed between the labia to avoid their mutual contact, or the vagina plugged with a pessary of tannin. While the inflammation is acute, salines and low diet must be ordered; but 'the exhibition of specifics (copaiba or cubebs) in the gonorrhœa of women is perfectly futile, unless

Treatment
of gonor-
rhœa in the
female.

the urethra be affected, and even then they seem to be productive of little, if any, benefit.' (Lee.)

Considerable confusion has been caused by the different manner in which the term syphilis has been applied. Formerly, as above stated, it was employed to denote all forms of venereal disease, including gonorrhœa. Then this disease was excluded, and syphilis was employed to designate a disease produced by contagion and characterised by the appearance on the part inoculated of one of two different kinds of sore, one of which was followed by secondary or constitutional symptoms, the other was not. Nowadays it is for the most part customary to confine the term syphilis to the former of these, that is to say, to that class of contagious sore or chancre which is followed by secondary symptoms, and to consider the others as a separate group, under the name of non-infecting chancre, chancroid, or local soft sore. There can be no doubt that this nomenclature is a distinct advance, since the two diseases have nothing in common, beyond the fact that they are usually contracted in the same way. In the one the disease is local merely, never affecting the constitution, and followed, therefore, by complete recovery as soon as the local mischief is healed; while the other constitutes the most obstinate infection to which the human subject is liable, remaining during the whole of the person's lifetime (in the more obstinate and inveterate cases, which, however, are happily rare) as a constant source of trouble and danger, breaking out after long intervals of health in one part of the body after another, and being transmitted through the blood of the mother or the semen of the father from one generation to another. Hence some pathologists assert that the two diseases are produced by two wholly different kinds of virus, and that the one disease can propagate itself and no other, though they admit that the two diseases may coexist in the same person. Other pathologists, again, believe that there is but one poison, and that the non-infecting sore is produced by the contagious products of peculiar forms of inflammatory action occurring in syphilitic sores, but which at the time of inoculation do not contain any of the specific virus of syphilis. This has led to the division of syphilographers into two schools—the *unicist*, who believes that the non-infecting sore is an outcome of true syphilis, and the *dualist*, who believes that the two diseases are entirely distinct.

Without entering into this controversy, I think it sufficient to say that it is more convenient for purposes of description to consider the two diseases under separate heads, and adopt the definition above given without involving oneself in any theory. The contagion in both diseases is always conveyed by direct inoculation, generally, of course, in sexual intercourse, but accidentally in other forms of personal contact, as when a surgeon inoculates a wound in his finger by touching a syphilitic sore, or a wet-nurse inoculates a crack on her breast by suckling a syphilitic infant.

Local or
non-infect-
ing sore.

To commence with the local form of venereal disease. This is a sore of special form, almost always situated on the genital organs. It is produced by direct contagion from a chancre, and if the secretion from it is inoculated into another part of the patient's body or into another individual, the same sort of sore will be produced. This inoculation may be repeated in the same individual for a considerable number of times, but the sores gradually become smaller and less characteristic, and at length a time arrives when the patient appears to become insusceptible to the poison, or the poison becomes so attenuated that it can no longer produce its effects. For I have seen in

some of these experiments a time arrive when the patient was no longer susceptible to the poison with which he was originally inoculated, but when inoculated from the discharge of a chancre from another patient a fresh crop of sores was produced. An important difference, therefore, between the hard and soft sore is, that the latter is often multiple, some healthy part becoming inoculated from the discharge of the original sore; while the hard sore is rarely multiple—never unless more than one inoculation has been produced at the same time. Then, of course, as in vaccination, where the virus is generally inserted in several places at the same time, more than one sore may exist; but this is rarely the case.

The non-infecting sore exhibits itself in three principal varieties.

The common soft sore may appear at any time after connection. It may begin with slight swelling and redness, then the formation of a vesicle, which soon becomes pustular and ulcerates; or an excoriation produced at the time of connection may begin to suppurate at once. The sore looks as if a piece had been chipped or punched out of the part, its borders defined, and often slightly undermined, its base sometimes thickened by the inflammation of the tissues under it. But this hardness is different in character from that of the Hunterian chancre, as will presently be pointed out. The sore heals, with no remaining induration, in three or four weeks. In many cases there are two or more sores at the same time. Sometimes the orifice of the prepuce is surrounded by a ring of radiating cracks or sores. The disease is frequently attended or followed by an inflammatory enlargement of the lymphatic glands, which receive the lymphatic vessels coming from the inoculated surface. They commonly suppurate, and it is found by experiment that the matter taken from the suppurating gland is contagious. In some rare instances the inguinal glands enlarge and suppurate without any breach of surface on the genitals. This is said to occur from the direct absorption of the specific poison.

The common soft chancre.

When these sores are inflamed from any cause, the inflammation may propagate itself to the prepuce, causing phimosis; and if the surgeon has not seen the case before this has taken place he may be uncertain whether it is one of balanitis or chancre. A correct opinion can, however, be generally arrived at by feeling the glans through the prepuce, by the history of the case, and by the presence or absence of scalding. It is important that a diagnosis should be made, as it is necessary in these cases to slit up the foreskin and freely expose the sore, and it is usually advisable at the same time to complete the operation of circumcision. Otherwise an inconvenient pendulous flap of skin will be left. Formerly it was believed that if this was done the edges of the wound would become chancrous. But if the whole of the parts are carefully cleansed with a one-in-twenty solution of carbolic acid, and the surface of the sore mopped over with a solution of chloride of zinc (40 grs. to the ℥j.), this will rarely take place.

The phagedænic sore is characterised by a tendency to erosion and destruction of the parts which it invades. This is sometimes rapid, sometimes slow in its progress, but it is always continuous and obstinate. It may attack either the infecting or non-infecting chancre; though Mr. Hutchinson believes that the soft sore 'very rarely assumes the condition of true phagedæna.' It occurs generally in debilitated, broken-down subjects, and in severe cases may be accompanied by sloughing. As a rule the ulcer presents an irregular form, with sharply cut edges, gradually destroying and eating

Phagedænic sores.

into the tissues, and is accompanied by thin and offensive discharge. There is often much pain and considerable constitutional disturbance.

Sloughing
sores.

The third form of local chancre is the gangrenous, a more serious affection than either of the others, but usually resembling them in not being followed by secondary symptoms. The gangrene is of the moist variety, spreading sometimes with alarming rapidity. In the male, the end of the penis becomes enormously swollen, of a hard, brawny feel, and of a dusky-red colour. The prepuce cannot be retracted. Soon a black spot appears in the centre of the swelling, which rapidly spreads. Foul blood-stained pus exudes from the orifice of the prepuce. Offensive pultaceous sloughs are formed, which separate. In this way a portion or the whole of the foreskin may be destroyed and the glans penis itself involved. It is more commonly seen in this country in women, who are almost always prostitutes, broken down by want and debauchery; but in military practice it shows itself sometimes, in soldiers who have become debilitated from hard service, exposure, or from excesses, as a kind of epidemic affection, which occasionally assumes formidable proportions. It appears frequently to be the result of want of proper cleanliness. It occurs either primarily, the sore sloughing as soon as formed, or a previously formed sore takes on a sloughing action. It does not affect the absorbents, nor is it followed by secondary symptoms; but it often spreads to a dreadful extent, and may even prove fatal by exhaustion or by hæmorrhage in the separation of the sloughs.

Treatment.

The treatment of the simple local non-infecting sore is now reduced to a very simple matter in the majority of cases. There are very few of them which will not yield and heal rapidly under the local application of iodoform. This remedy appears to have some direct effect on the poison, and under its use the sore rapidly heals. It is best applied by sprinkling the surface with the crystal twice a day, and then covering the part with a little medicated cotton-wool. The parts should be well washed before each application; walking and riding exercise should be restricted and the diet regulated. The only objection to the use of iodoform is the unpleasant odour which it possesses. This may be disguised to a certain extent by mixing it with an equal proportion of oleate of zinc, or with a like amount of quinine—a form of application which I have found particularly efficacious. Iodoform may also be applied in the form of an ointment, a drachm of the drug to an ounce of benzoated lard, when the addition of a few drops of oil of bitter almonds will effectually disguise the smell. In cases where iodoform is objected to, black-wash may be applied; and under its influence the sore will generally heal, though not so rapidly as with iodoform. Some surgeons recommend the cauterisation of the sore with nitric acid; but the treatment is entirely superfluous, and only causes unnecessary pain. In the phagedænic form the erosion can generally be arrested by regulation of the digestive and other systems, a generous diet, and the application of iodoform or solution of corrosive sublimate (gr. 1 to ʒj.). In many cases I have found the application of a lotion consisting of two grains of sulphate of copper and four of extract of opium to an ounce of water act very beneficially. If the phagedæna is of the sloughing variety it is occasionally necessary to destroy the surface with nitric acid. Sloughing sores must be treated by freely slitting up the prepuce, which relieves the tension and at once lessens the intensity of the inflammation. The parts are then to be well soaked in a forty-grain-to-the-ounce solution of chloride of zinc and warm boracic lint, or charcoal or yeast poultices applied. The general treatment must consist in

free doses of opium, diffusible and alcoholic stimulants, and very nutritious diet.

The constitutional form of syphilis, *syphilis proper*, or *infecting sore*, is distinguished by the occurrence on the genital organs, or other part primarily affected, of a peculiar form of chancre, the 'hard' or 'Hunterian' chancre, which is characterised by the occurrence of adhesive inflammation in the neighbourhood of the ulcer, producing a peculiar induration, and by a chronic engorgement of the lymphatic glands, which are very slow to suppurate even on irritation, and which under ordinary circumstances remain in an indolent condition for an indefinite time, forming a bunch of hard knobs under the skin ('amygdaloid glands'). The chancre begins at a variable time after exposure to contagion. It may be as early as three or five days, but well-authenticated instances are on record in which several weeks have elapsed.¹ Slight itching is first noticed at the part, then redness, and a small vesicle forms, which soon cracks, and induration shows itself at the base of the crack; the sore spreads and becomes excavated and glazed, with little or no granulation on its surface. Its natural secretion, if examined microscopically, is found not to be purulent, but to contain only a little granular matter; though the sore can be made to suppurate by the friction of the clothes or by irritating applications. The hardness at the base of the ulcer from which the sore takes its usual appellation is of a peculiar kind; different from that which is found at the base of a soft sore, in this, that in the Hunterian chancre the hardening feels as if due to a ring of cartilage or other hard material let into the tissues; that is to say, it is of limited thickness, and abruptly ceases where the healthy tissues commence; while the hardness at the base of a non-infecting sore, being due to the infiltration of lymph from common inflammation of the cellular tissue, is of a much less defined character, extends farther, and fades away much more gradually into the healthy tissues. It must be remembered that the nature of the tissues in which the sore is seated will much affect the amount of hardness around it. Thus a sore will be much less indurated on the glans penis than on the prepuce, in consequence of the absence of any cellular membrane in the former.²

The constitutional or infecting form of syphilis. The 'hard' or 'Hunterian' chancre.

Diagnosis between the two forms of sore.

The nature of the secretions is also much relied on as a test between the infecting (adhesive) and the non-infecting (suppurative) form of sore. Mr. Lee says: 'If the secretion from an uncomplicated infecting sore be placed on a piece of glass, and a drop of dilute nitric acid be added, the microscopic appearances will be found to be very different from those characteristic of the secretion from a naturally suppurating sore. The secretion from an infecting chancre is not pus; it consists of epithelial débris, of globules of lymph more or less perfectly formed, or of these same products undergoing disintegration, and of serum more or less turbid. These different products may often be found matted together, mixed occasionally with a few pus-cells'; while of the secretion from the soft sore he says that 'it consists of well-formed pus; and

¹ Lancereaux gives a table of ten cases of inoculation with matter from secondary sores. The mean period of incubation was twenty-eight days. When the disease is derived from a primary sore the period of incubation is probably much shorter, but in two cases related by him it was eighteen days.

² See a paper by Mr. Cant in which he gives his experience as to the induration in the primary lesion of syphilis in women, from observations made during a period of six and a half years upon females admitted into the Royal Albert Hospital, Devonport, and regularly examined under the Contagious Diseases Act. He states that the induration when present does not of itself absolutely distinguish the primary character of the sore; and when absent it does not prove conclusively the absence of the syphilitic poison. 'Med. Chir. Trans. vol. lxx. p. 169.

each globule is of nearly the same size and distinct from the rest. If, in any doubtful case, some of the secretion from a sore be mixed with a little dilute acetic acid and placed under the microscope, the distinctive character of the pus-nuclei will be seen.¹ The annexed figures, borrowed from Mr. Lee's work, will render the distinction obvious. But Mr. Lee takes care to explain that this distinction depends for its clearness on the absence of irritation of the sore. And I think I may add that both of these tests are more applicable to the male than the female sex; for in women chancres presenting the characteristic induration are indisputably rare, and suppuration is far more easily excited in a chancre within the vulva than in one of the penis. Another very reliable test is the nature of the accompanying bubo, the indolent hard bubo which is caused by the infecting sore being easily distinguished from the irritable, inflammatory, and rapidly suppurating bubo of the local sore. Again, the bubo of soft chancre usually affects a single gland, while the indolent bubo consists more commonly of several. I have not enumerated among these diagnostic symptoms the inoculability of the secretion on the patient's own body. The reader is referred, on this head, to the section which treats of

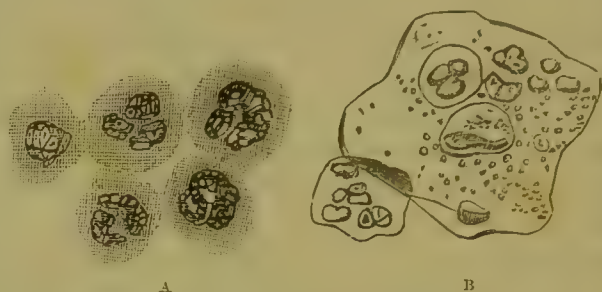


FIG. 182. A. Secretion from local suppurating sore, treated with dilute acetic acid and magnified 700 diams. B. Secretion from indurated sore, examined in the same way as A.—From Mr. H. Lee's Essay on Syphilis, 'Syst. of Surg.' vol. iii. 3rd ed.

'Syphilisation.' By one or other or all of these tests an infecting can usually be distinguished from a non-infecting sore; but it is undeniable that mistakes are tolerably often made.

The causes of mistaken diagnosis between the infecting and non-infecting forms of syphilis seem chiefly two: (1) That both forms may co-exist, i.e. both poisons may be inoculated at the same time, or a previously existing soft sore may, in a second connection, be inoculated with the virus of an infecting chancre, and the surgeon, deceived by the evidences of local syphilis, may overlook those of the constitutional disease; or the latter may be still dormant and undiscoverable;² or (2) the hard sore, and even in some cases the hard bubo, may by irritation be made to suppurate, and thus be taken for a soft sore or an inflammatory bubo. The above observations apply

¹ 'Syst. of Surg.' 3rd ed. vol. iii. pp. 317 and 315.

² Mr. Hutchinson teaches that 'the relationship of the soft to the hard sores is probably simply this—that the soft are due to the contagion of the pus produced by syphilitic inflammation, and the hard to that of the specific virus of syphilis,' referring to a clinical lecture on the relationship between soft and hard chancres in the 'Lancet' for Sept. 1875. He therefore believes that, apart from any reinfection, the hard chancre may succeed on the soft one. The explanation must be allowed to be still theoretical, and seems to me highly dubious; but the practical point which Mr. Hutchinson enforces is unquestionable, viz. that even with sores which are obviously soft and non-infecting 'until the incubation period is well passed (three to five weeks) the surgeon can entertain no confidence that induration will not occur, and he would act most unwisely to give his patient any opinion on the matter.' I presume Mr. Hutchinson means any absolute opinion, for there can be little doubt that in the great majority of soft sores no permanent affection of any kind ever ensues. The above statement occurs in the Commentary to Plate V. of Mr. Hutchinson's 'Illustrations of Clinical Surgery'; and I would refer the reader to the rules for the diagnosis of chancres there contained as embracing the experience of an eminent observer on this difficult subject. I have ventured to differ from him in his views as to the ordinary nature of phagedænic chancre.

to the mistake of taking an infecting for a non-infecting chancre, and to the refutation of that mistake by the appearance of secondary syphilis. How often a soft sore is pronounced to be a Hunterian or infecting chancre, and the patient is consequently exposed to a course of mercury which is really unnecessary, cannot be determined, since there is nothing to detect the mistake. No secondary symptoms follow, and both patient and surgeon congratulate themselves on the success of the treatment.¹

Besides the Hunterian chancre Mr. Lee describes two forms of infecting syphilis which are unassociated with ulceration, viz. (1) a pimple, the cuticle appearing as if peeled off the upper part of the glans penis, or a circumscribed patch remaining for days together, with a separation of epithelial scales mixed with lymph-globules from the surface, but with no specific induration; and (2) an indurated tubercle, formed below the skin or mucous membrane, without any visible loss of substance. The latter is regarded by many surgeons as a chancre which has skinned over. Infecting sores seem to be almost always single.

When a sore has been diagnosed as infecting—i.e. as likely in the ordinary course to be followed by constitutional symptoms—the next question is as to the treatment. An immense preponderance of opinion at the present day supports the doctrine usually taught—and which I must say that I hold unreservedly—that the only efficient treatment for constitutional syphilis is mercury, and that that treatment is usually efficient. In thus teaching, the rational and judicious advocates of mercury do not intend to assert that syphilis is any exception to the common rules which are observed in all other diseases, viz. (1) that diseases when left to themselves do not always run through all their phases, but that they may be spontaneously cured and disappear at any period of their course; so that constitutional syphilis, though it naturally tends to produce secondary symptoms, does not always do so, but may disappear spontaneously and no secondary or tertiary symptoms ever follow; and (2) that remedies, however efficient, are not always and uniformly successful; and therefore, that mercury, though when thoroughly given it usually eradicates the disease, and especially if given as soon as the disease shows itself, yet does not always do so, and therefore that secondary symptoms are sometimes seen even after a perfectly satisfactory course of mercury. But many of the cases which are cited by the indiscriminate opponents of the use of mercury (who, I may perhaps be excused for saying, are not altogether very correct diagnosticians) in order to prove that constitutional syphilis can be treated with success by other means than mercury, so that no secondary symptoms will follow, were, no doubt, instances of mere local syphilis; and in many of the cases in which mercury is said to have failed to eradicate the disease, so that secondary symptoms followed on its use, the course of mercury has been insufficient, or it has been begun after the secondary symptoms had really been developed.

The best form in which to administer mercury has long been a subject of dispute. The common plan of giving it by the mouth has the advantage of requiring no confinement to the house, and being easily carried on without attracting observation—an important and in some cases almost indispensable

Treatment.

Adminis-
tration of
mercury.

¹ An interesting summary of the opinions of the most experienced surgeons of the day on the diagnosis of infecting and non-infecting chancres will be found in a paper by Mr. Venning, in the 5th vol. of the 'St. George's Hospital Reports,' entitled 'A Summary of the Evidence adduced before the Committee appointed to inquire into the Pathology and Treatment of the Venereal Disease, published in 1867.'

condition in the treatment of these maladies ; but it has the disadvantage of seriously disturbing the digestion and general health of many patients. One of the mildest forms, and the most generally useful, is 'grey powder,' which may be given in doses of about three grains, combined with a little Dover's powder, twice a day. Or the blue pill, which is of the same strength as grey powder, but slightly more apt to purge, may be substituted. A formula which I have found very useful is blue pill gr. iij., quinine gr. jss., ext. hyoscyami gr. ss., to be given twice a day. The late Mr. H. C. Johnson used to use the ung. hydrarg. made into the form of a pill, as bringing the patient rapidly under the influence of mercury, and generally agreeing well with the bowels.¹ The mercury is to be continued, even if no secondary symptoms make their appearance, until all traces of the sore and all subcutaneous hardening around it and around the bubo have disappeared. During the course of mercury the state of the breath and gums should be cautiously watched. There is a peculiar fœtor in the mouth, easily recognised by the initiated, and usually accompanied by a coppery taste perceived by the patient, which generally precedes the spongy and congested state of the gums. When the latter sets in, and the blue line is seen round the roots of the teeth, it becomes a little unpleasant to the patient to chew a crust. If the mercury be pushed, in undiminished quantity, salivation commences, and then the gums recede from the teeth—the latter may drop out, and even the jawbones may become necrosed.

The endermic method of giving mercury is much more easily tolerated, produces far less depression, and is quite as efficient ; but it is not so easily carried out, especially in private practice. In hospitals it is extensively used either by inunction or fumigation. The former consists in making the patient rub ʒss.—ʒj. of the ung. hydrarg. into the inner surface of the thigh (where the skin is thin) until the ointment has entirely disappeared. In the latter the patient sits naked on a cane-bottomed chair, with a mackintosh sheet, or a cloak, or a common blanket wrapped round his neck and reaching to the ground all round the chair. Under the chair is placed a spirit-lamp, over which is a saucer containing a little boiling water, and projecting out of the saucer a shelf² on which is laid powdered calomel, gr. x.—xx. As the water evaporates its vapour mixes with the sublimed calomel, and the fine powder is deposited on the moistened and relaxed skin, which is thus prepared to absorb it. The quantity of calomel, of water, and spirit is so adjusted in the regular lamp that when the flame goes out the saucer is dry and all the calomel sublimed. The patient should sit quiet for a few minutes, then put on his nightgown, and without wiping the skin at all get into bed. In hospitals, when the patient is confined to bed, the bath may be given at any time : in private practice it should always be at bedtime, since any check to the perspiration spoils the action of the remedy. It will usually be found that after about twelve baths, given every other day, the patient begins to get slightly affected. Then the action should be kept up by decreasing the quantity of calomel, so that the patient should just be conscious of the mercurial taste.

Subcutaneous injection of mercury has been employed by Lewin and others, and its employment has lately been strongly advocated by Bloxam,

¹ The formula for 'Sédillot's pill' is strong mercurial ointment, powdered marsh-mallow, and soap, of each $1\frac{1}{2}$ gr.

² This little apparatus can now be had at any instrument-maker's. If a proper apparatus is not at hand an extempore contrivance may be made out of a common saucer with a piece of hot brick laid in the water, on which the calomel is to be strewn.

who recommends the injection of one-third of a grain of the perchloride of mercury once a week into the muscular tissue of the buttock. He says that as a rule not more than twenty-four to thirty-six injections are necessary, and that under its influence the sores begin to heal very promptly and secondary symptoms are markedly modified.¹

The action of mercury is made much more safe, speedy, and certain by confining the patient to bed; though, of course, this is seldom possible in ordinary cases of syphilis; and, as my late friend and teacher Mr. Cutler used to point out, it is a very useful precaution to weigh the patient every three or four days. A rapid loss of weight will often show that the remedy is disagreeing, and will spare the patient some more disagreeable proof of the fact.

When the patient cannot tolerate mercury the iodide of potassium may be administered; but it does not appear to exercise any radically curative influence on the syphilitic cachexia, though it rapidly removes some of its remoter effects. The other alleged remedies for syphilis are now generally thought to be quite inert.

There are surgeons who, while they admit the power which mercury exerts over the constitutional manifestations of syphilis in its secondary form, deny its power of preventing secondary symptoms, and therefore repudiate its use in primary syphilis. These are reduced either to an expectant treatment or to the extirpation of the sore by means of caustic. But there seems little proof of the advantage of such extirpation even when practised during the period of incubation,² and no proof at all that when the sore has become developed any advantage could be derived from its removal.

The secondary symptoms of constitutional syphilis appear at a variable period after the original inoculation, usually not till after the primary sore has healed, which it will commonly do, if left to itself, in about six weeks, though hardening may persist and the cicatrization may not be quite sound. The period, however, is quite uncertain at which secondary syphilis shows itself. In the great majority of cases it is under half a year, but there seems no time of life at which a person can be pronounced absolutely safe, though doubtless most of the histories which we have of persons who have suffered from constitutional symptoms (secondary or tertiary) a very long period after the primary sore are mistakes or wilful inaccuracies, the patient having really contracted the disease afresh in the interval.

Secondary
syphilis.

Sometimes, it is said, the advent of secondary syphilis is ushered in by what is termed 'the syphilitic fever'; 'the patient feels feverish and uncomfortable, the skin becomes dry, and the tongue perhaps coated,' and rheumatic pains are complained of, especially in the head and at night.³ It is certain, however, that secondary syphilis is very often developed with no such premonitory symptoms. The first symptoms are generally either in the

¹ 'Lancet,' August 21, 1886, p. 337.

² In Lancereaux's 'Treatise on Syphilis,' translated for the 'New Syd. Soc.' vol. ii. p. 304, will be found an account of some experiments by Sigmund on the removal of syphilitic sores by caustic, but they are by no means conclusive. I have seen other statements on the same subject; but none which appear to me of any practical value. Lancereaux himself, though he rejects the mercurial treatment in ordinary cases of primary syphilis, even when the hardness of the Hunterian chancre is well-marked, because he says it does not prevent the occurrence of secondary symptoms, yet admits its necessity when the hardening is long in disappearing.

³ In Lancereaux's work, vol. i. p. 125 et seq., will be found a very complete account of these premonitory symptoms of secondary syphilis.

throat or the skin, the early skin-eruptions being usually either roseola (very common in young girls) or lichen, and the sore-throat being referred with great probability to the formation of similar spots on the mucous membrane of the mouth or fauces. The syphilitic eruptions which are peculiar to the secondary or earlier stage of the constitutional disease are all considered to resemble each other, and to resemble the primary sore in the fact that they depend on, or tend to, the effusion of adhesive or fibrinous material in the neighbourhood of the inflamed part; and the same is the case with the lesions of other parts of the body, as the eye, the bones, &c. As the disease progresses into its later secondary and into the tertiary stages the tendency to ulceration and suppuration becomes more marked.¹

The earlier eruptions are either exanthematous (roseola), papular (lichen), tubercular (syphilitic acne on the skin,² mucous tubercle on the mucous surfaces or their orifices), or squamous (psoriasis). They are distinguished from the similar eruptions which are not specific partly by conforming less completely to the regular form, partly by their colour, which in English works is generally described as coppery, and in the French more accurately as the colour of lean ham, and partly by their circular or horse-shoe form and the tendency they have to disappear in the centre while creeping or spreading at their edge, from which the old term 'serpigo' was derived. They are also generally 'polymorphous—that is to say, not limited to one type, but in the same subject are seen one form mixed with another. There is also absence of pain or itching. As the disease progresses vesicular and pustular eruptions are seen, the latter especially on the hairy scalp.³

Many other tissues of the body are, however, affected in secondary syphilis, though the deeper the parts affected are, the later probably is the stage of the disease, and the more it approaches to the tertiary period. Thus the eye and the larynx are affected in the later secondary stage—both parts of the general surface of the body, but lying deeper than the common integument, and liable also to be involved in the tertiary symptoms. The superficial affections also of the bones (periostitis or nodes) are seen at the later periods of secondary as well as in the tertiary stage; but the deeper affections of the bones (caries and necrosis) are as a rule tertiary symptoms. The ulcerations of the skin which are due to syphilis may be the result of the giving way of skin affected by secondary eruptions, but are far more common after the suppurating eruptions (pemphigus, ecthyma, and rupia) which are characteristic of the tertiary stage. The affections of the viscera, such as the tubercles in the liver and the 'cirrhosis' of the lung, which are due to syphilis, seem to be amongst its later manifestations, though in some cases they have been noted as secondary.

Mucous
tubercle.

Other secondary symptoms must be briefly, but very briefly, mentioned. One of the most important is the development of 'mucous tubercles'—flat, raised, oval patches, generally situated at or near the junction of the skin and mucous membrane, covered with a whitish velvety epidermal tissue, and yielding a secretion which is easily inoculable, and which is probably a fertile source of syphilitic inoculation. Their usual seat is near the anus or vulva,

¹ Lancereaux divides a complete attack of constitutional syphilis into four periods: 1. That of incubation. 2. That of local eruption or primary lesion. 3. That of general eruption or secondary affection. And 4. That of gummy [gummatous] products or tertiary and quaternary affections.

² Acne is generally, however, a late secondary symptom, and is often regarded as one of the tertiary forms.

³ I would refer the reader for further details to the chapter on SKIN DISEASES.

and the mouth is a common situation; but any part of the body may be affected, especially where the skin is in folds, and where it is irritated by heat, dirt, and retained discharges. The local action of mercury is very beneficial in these cases. The tubercle generally disappears rapidly under the use of powdered calomel, kept upon it by means of some simple ointment, strict cleanliness being, of course, enforced. In the mouth, the local application of a ten-grain solution of chromic acid, as recommended by Mr. Butlin, generally succeeds in curing the disease. Syphilitic vegetations and condylomata are very nearly allied to mucous tubercle, and, like it, seem decidedly contagious. They will be best described in the chapter on SKIN DISEASES. A common secondary affection is syphilitic baldness, or 'alopecia.' The hair of the head becomes thin, comes away plentifully in combing, and at length the patient may become almost or entirely bald. There are cases, much less common, in which the baldness attacks other parts, usually the chin and eyebrows. The remedy lies in shaving the head, applying some gently stimulating lotion,¹ or in more serious cases painting the part occasionally with blistering fluid. But far more important than the local treatment is the correction of the syphilitic diathesis by a proper mercurial course. Alopecia, like many other of the symptoms which usually are secondary, appears also in the tertiary stage of the disease. Alopecia is often accompanied by desquamation of the epidermis. Onychia, again, is an affection very nearly allied to the affections of the skin and hair, and is often described as a psoriasis of the nails. I must refer the reader on this point also to the chapter on affections of the SKIN.

Alopecia.

Syphilitic sore-throat is an almost universal symptom in the secondary stage, and generally the earliest of its phenomena. But affections of the throat are also to be met with in the later secondary and in the tertiary stages. The main forms of syphilitic sore-throat are three: ² 1. The sore-throat which is due apparently to the development of psoriasis on the mucous membrane of the fauces or mouth. This is distinguished by the opaque white colour of the surface. 2. The ulcer of the tonsils, a deep ulceration commencing on the surface of the central part of one or both tonsils, and accompanied by swelling and induration of the gland around it. This is said by Mr. Babington to be often accompanied by a tubercular eruption. 3. The phagedænic or sloughing sore-throat, commencing with ulceration on either the tonsils, the velum palati, or the pharynx, and often leading to extensive destruction of those parts. This is usually accompanied by rupia, and is therefore a later phenomenon. There are other forms also of syphilitic sore-throat, but the above are those which are commonly met with.

Sore-throat.

Next in importance to the affections of the skin and its appendages are those of the glands. The glands are very liable to secondary and tertiary syphilitic enlargement apart from all affection of the parts from which they derive their lymphatics. In those affections which are excited by the presence of eruption the gland is more disposed to inflammation than those which are due to the effect of the general syphilitic poison. The posterior cervical glands, those lying in the posterior triangle of the neck, are the most commonly affected, independently of other organs in constitutional syphilis, forming a chain of hard, knotty tumours under the edge of the trapezius muscle. The inguinal glands below Poupart's ligament are also often found

Affections of glands.

¹ Mr. Nayler prescribes the following:—Liq. Ammon. Acet. ℥ss., Sp. Ammon. Co. ℥ss., Glycerine ℥ss., Aq. Rosæ ad ℥viij.

² See Hunter's works, vol. ii. p. 415, note by Mr. Babington.

thus affected. These glandular affections are more marked either at a later stage of the secondary or in the tertiary stage. The other common secondary affections are those of the periosteum, of the testicle, of the larynx, and of the eye; for which I must refer the reader to the chapters on diseases of those organs.

Inoculability of secondary syphilis.

That secondary syphilis is inoculable on a healthy person has been abundantly proved,¹ and practitioners of experience seem now to be of the opinion that syphilis is very often propagated in this manner. Mr. H. Lee has lately called particular attention to the controversy which has been going on ever since the days of Hunter on this subject. Hunter taught that the contagion of all venereal diseases—gonorrhœa, local syphilis, and constitutional syphilis—was the same, though he appears to have been perfectly acquainted with the fact that some kinds of sores are local only; and he taught also that secondary syphilis was not inoculable on the patient's own body, while he doubted (though, as Mr. Lee shows, he did not deny, as he is usually represented as doing) that it can be inoculated on a healthy person. The experiment on which Hunter mainly relied for showing the identity of the gonorrhœal and syphilitic poisons was one which he made on himself by inoculating on his own person matter taken from a patient suffering, as he thought, only from gonorrhœa, and this inoculation produced primary and secondary syphilis. But Mr. Lee has called attention to the comparative frequency of discharges from the male urethra the precise nature and seat of which has not yet been ascertained, but which seems to affect any part of the tube from the prostate forwards.² This affection is analogous to those somewhat rare cases in which the bronchial or the gastro-intestinal mucous membrane is affected in secondary syphilis, probably with some of the forms of eruption which are seen on the skin. The matter with which Hunter inoculated himself was, therefore, probably syphilitic.

Treatment.

That secondary syphilis requires the mercurial treatment for its cure is admitted by many even of those who do not use mercury in the treatment of the primary disease. But the course of mercury must be more prolonged, and therefore milder, since the patient's general health is to be maintained during the whole period. The symptoms will, indeed, rapidly subside in many cases under the use of iodide of potassium, especially such as are accompanied by perceptible fibrinous exudation. It is, however, I think, generally admitted that such cures are usually only temporary, and that for the complete eradication of the diathesis a full and prolonged mercurial course is necessary. No hesitation need be experienced in prescribing mercury in cases where there is no ulceration or suppuration; but when this is the case mercury is generally held to be contra-indicated. I think, however, that any one who will make trial of the fumigation of syphilitic ulcers or syphilitic eruptions of the pustular form, with very small doses of calomel (say 5 grains every night), will be convinced of the great benefit of this form of treatment. In many cases also of ulcerated sore-throat mercurial fumigation or a mercurial gargle acts most favourably. In conditions of extreme cachexia, indeed, every form of mercury may be inadmissible; but in such conditions iodine is generally inadmissible also, and the patient's health must be renewed by careful feeding, stimulants in moderation, rest (if possible, in bed), tonics, and opium, before any definite treatment is commenced. I know

¹ See 'Lancereaux,' vol. i. p. 69.

² See Mr. Lee's Lettsomian Lectures, published in the 6th vol. of the 'St. George's Hospital Reports'; also his Lectures at the Royal College of Surgeons in 1875.

of no tonic which seems so generally beneficial as the compound decoction of sarsaparilla, a pint daily, with steel wine and laudanum if necessary. The administration of iodine and mercury together is a very successful plan of treating secondary syphilis. Thus the iodide of potassium may be given in doses of 5 to 10 grains, while the patient is undergoing a course of mild mercurial fumigation; or the red or green iodide of mercury may be prescribed either in pill or draught. The red or biniodide is the salt generally used, and may be given in doses of $\frac{1}{16}$ to $\frac{1}{8}$ of a grain in a pill three times a day, or in a draught by combining the iodide of potassium, gr. v.-x., with the liq. hyd. perchlor., 3ss.-j., in some bitter infusion.

The tertiary stage of syphilis is distinguished from the secondary by the occurrence of an interval of health. The secondary symptoms have disappeared, with or without treatment—for I repeat that secondary syphilis does sometimes disappear spontaneously—and then, after a very variable interval, commences the stage usually called tertiary, or, as Lancereaux puts it, the stage of the gummatous products.

Tertiary
syphilis.

During this period of apparent health, and before the appearance of tertiary syphilis, there is often a relapse, during which the patient presents symptoms which to a greater extent resemble secondary symptoms than the tertiary form. These have been termed by Mr. Hutchinson and others 'reminders,' and affect principally the skin, the tongue, and the testicle. Thus psoriasis palmaris; leucomata, and superficial ulcers on the tongue; sarcocele, in which the whole testicle slowly and painlessly enlarges, belong to this intermediate stage. Mr. Hutchinson believes also that syphilitic disease of the arteries, principally affecting the cerebral vessels, and leading to disease of the brain, belongs also to this intermediate group.

The main distinctions between the tertiary and secondary stages of syphilis are, that in the former the morbid process is locally infective and has a tendency to spread, and not undergo spontaneous cure, and that the new growths resemble more the products of inflammation, regarded as an ulcerative process; while in secondary syphilis the new growths resemble more the products of inflammation, regarded as a reproductive process.

In fact, a gumma bears a very great resemblance to a granulation, and it is prone to soften, break down, and leave an ulcerating surface. Dr. Green thus describes the structure of gummata: 'The gummata consist of atrophied and degenerated elements embedded in a scanty and obscurely fibrillated stroma. The central portions of the growth are composed almost entirely of closely packed granular débris, fat-granules, and cholesterine, amongst which there may be an exceedingly scanty fibrillated tissue. Surrounding this, and directly continuous with it, is a more completely fibrillated structure; while the peripheral portions of the growth, which are continuous with the surrounding tissue, consist entirely of small round cells, resembling granulation cells and lymph-corpuscles. The blood-vessels, which only exist in the external portions of the growth, are very few in number.'¹

It is not, however, in every part that such gummatous tumours can be observed preceding the ulceration of tertiary syphilis; nor, again, do these gummata always ulcerate. In many cases the ulceration occurs without any recognisable deposit, being, however, probably preceded by a similar aplastic deposit diffused in the cellular tissue of the part. And in the interior of the body, as well as near the surface, tertiary syphilitic deposits may long remain inert, and then wither away into a kind of cicatrix or be reabsorbed.

¹ 'Pathology,' p. 120.

The affections characteristic of tertiary syphilis appear in every part of the body, and I cannot affect to give a complete account of the matter here. I will endeavour to direct the reader's attention to the points most commonly met with in practice. For the rarer and more dubious lesions which are connected with syphilis, such as the affections of the viscera and the nervous system, special works on the subject must be consulted.

The affections of the skin which are seen in tertiary syphilis are of the suppurative and ulcerative type—*rupia* and *ecthyma* are the commonest eruptions; and the softening of the subcutaneous gummata frequently leads to ulceration. The various forms of syphilitic ulcer are described in the following chapter. Even more important than the external affections are the diseases of the bones which so constantly occur in tertiary syphilis, and which now no longer affect only the periosteum and external table of the bone in the form of nodes which show little tendency to suppuration; but, on the contrary, the tissue over the bone rapidly softens and exposes a cari-

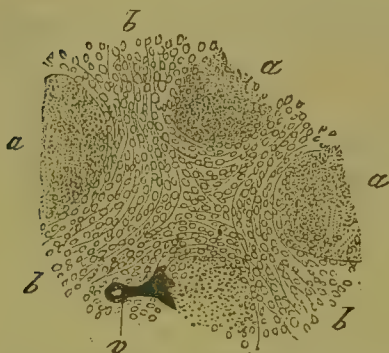


FIG. 183. Syphilitic gumma from the liver. *a*, Centre of the nodules in which the cells have become granular. *b*, Periphery of these nodules. *v*, Vessel. Enlarged 100 diameters. From Cornil and Ranvier.



FIG. 184. The same preparation enlarged 400 diameters. *d*, Elements of the gumma. *f*, Cavity of the vessels in which the red globules *g* are seen.

ous or necrosed condition of the bone itself, which is regarded as being the result of a similar aplastic deposit in the substance of the bone to that which we have just spoken of as met with in the cellular tissue of soft parts. These syphilitic affections of bone will be afterwards more fully treated of in speaking of the DISEASES OF THE BONES. The glands are deeply affected in tertiary syphilis—not exclusively, or even mainly, the absorbent glands (though the induration of the posterior cervical and inguinal glands is constant in tertiary syphilis), but also the great secreting and blood glands—the liver, spleen, thyroid, testicle, &c.—and it seems probable that though generally the syphilitic deposit occurs in the form of definite masses (gummata or syphilitic tubercles), yet that the diffused waxy or lardaceous disease of these organs may also be sometimes of syphilitic origin. The nervous system is also profoundly affected, not merely by inflammation propagated to the brain, spinal marrow, and nerves from their bony cavities, but by tertiary deposit in the structure of the nervous masses or their membranes, leading to irritation or paralysis.

Thus it seems that there is no part of the body which may not be and is not constantly affected in constitutional syphilis.

The lesions met with in constitutional syphilis have recently been thus described by one of the greatest living authorities on the subject, Lancereaux: ¹

¹ This account is somewhat modified from the *résumé* of a lecture by Lancereaux in the 'Gaz. des Hôp.' for October 25, 1877.

On the skin, nodules or projecting tubercles, grouped and circumscribed, leaving indelible cicatrices; in the cellular tissue similar tubercles, often more voluminous, which sometimes are absorbed, at others eliminated by ulceration of the skin over them; in the voluntary muscles, nodules of the same kind, which are usually absorbed, leaving a cicatrix in the muscle; in the articulations grey or yellowish deposits, usually in the subsynovial tissue, sometimes in the substance of the ligaments, such deposits being localised generally in the great joints—the knees or elbows—usually in one or two only, and most frequently in symmetrical articulations; in the bones, the syphilitic lesions are also as a rule circumscribed, producing limited periostitis or limited periosteal deposit, the new bone differing from the normal bone chiefly in the manner of its connection with the shaft, and in the greater size of its medullary cavities. In later stages of syphilis the bone perishes extensively, in consequence, as it seems, of an invasion of its tissue by gummatous material, which either obstructs its nutrition entirely, giving rise to necrosis, or breaks down in larger or smaller tracts, and so leads to syphilitic ulceration or caries. In the lymphatic glands, the syphilitic deposit is usually rather organisable than ulcerative; so that they are enlarged in volume by syphilis. In the arteries, the syphilitic deposits are also prone to be circumscribed; so that, though in some cases they affect the whole circumference of the vessel, or obliterate it, more commonly they are limited, giving rise to lateral softening and aneurism. Such deposits are noted also in the lymphoid tissue which forms the sheaths of arteries in certain situations, and syphilitic lesions are very common in cerebral vessels, easily distinguished by their limitation from the general degeneration of ordinary atheroma (endarteritis). In the viscera, the lesions of syphilis display the same general characters: those of the liver and testicle being extremely like each other; the organs being sometimes traversed by fibrous bands, more or less retracted, often radiating from a common centre, sometimes sprinkled with masses of deposit, the central part of which softens into a gumma, while the circumferential organises and forms a cicatrix. The same phenomena are observed also in the lungs, kidneys, and brain.

Summary of the principal lesions met with in constitutional syphilis.

The treatment of the tertiary must be the same in principle as that of the secondary stage of syphilis. But here again, as the cachexia is more profound, so must the treatment be milder, more supporting and stimulating, and longer continued. The iodine or mercury which may be necessary for the treatment must be introduced gradually in very small doses combined with tonics and opium. Wine and good food are essential. Change of air, a warm climate, and the use of appropriate mineral waters are most useful adjuncts to a treatment which must be carried on through so long a period of time.

Treatment of tertiary syphilis.

The length of time during which a course of mercury should be continued is stated by Ricord¹ at about twelve months, and Lancereaux estimates it at about half a year. In such prolonged courses the mildest preparations of mercury must be selected, the dose must be a very moderate one, intermissions must be allowed from time to time, and the preparation and vehicle must be varied.

Two special forms of syphilis remain to be described—infantile or congenital syphilis and vaccino-syphilis. Congenital syphilis is a form of secon-

Infantile or congenital syphilis

¹ See Carter 'On the Principles of Ophthalmic Therapeutics,' 'St. George's Hospital Reports,' vol. vii. p. 111.

dary or constitutional disease, transmitted to the fœtus in utero either through the blood of the mother or the semen of the father, or both. The old idea that infants are inoculated with syphilis at the time of birth from syphilitic sores in the mother's vulva is given up. Such an occurrence may be possible, but the disease which we usually see is strictly analogous to secondary syphilis, and is, in fact, a form of it, differing only in this, that the primary sore has occurred on the body of the parent instead of the infant itself.

Through the placental circulation the child can be infected up to a very late period of utero-gestation. Hence it frequently happens that it is born plump and apparently healthy, and the symptoms do not show themselves till some weeks after birth. If infection takes place earlier, it usually leads to the death of the fœtus in utero and then to abortion.

It is believed that the affection in the parent becomes milder as the stage of the disease is later, so that the later children are less profoundly poisoned than the earlier. Thus there are families in which, after several abortions, a child has been born alive, but with advanced congenital syphilis, and soon died; the next has perhaps survived, and the later children have shown no marks of the disease for the first few months of life, or even perhaps at all.

The popular name of infantile syphilis is the 'snuffles,' and this expresses one of its chief and earliest symptoms—a persistent coryza, or snuffling in the nose. This arises from a chronic inflammation and swelling of the mucous membrane of the nasal fossæ, which obstructs the passage of air. The inflammation frequently extends deeply to the periosteum; and thus the development of the nasal bones is interfered with and the child grows up with a flattened, sunken bridge to the nose. Parts of the body become covered with a coppery or 'lean-ham coloured' eruption, usually either roseola or lichen, especially the genitals and the palms and soles. In these latter situations, however, it is sometimes more of a scaly nature. Pustular or bulbous eruptions occasionally appear. There is frequently a more or less general stomatitis, with the presence of crescentic patches of mucous tubercle on the interior of the mouth and lips, commonly known as the 'thrush.' Similar patches are also constantly found around the anus and on the pudenda. The angles of the mouth become inflamed, leading to the formation of radiating fissures which may remain throughout the life of the individual. The larynx is sometimes congested; and this leads to a peculiar hoarse cry, which is very characteristic of the disease. The child, if born plump and apparently healthy, soon begins to emaciate and present a peculiar cachexia. It becomes wan and withered, with pinched features and a wasted look like that of old age, and a yellow or earthy complexion, or it presents these symptoms from birth.

Lately the subject of the syphilitic affections of the bones in infancy has been more carefully examined, and it appears that such affections are not so rare as was at one time believed. Syphilis affects both the flat bones, as the bones of the skull, or the long bones of the extremities. In the bones of the skull it shows itself in two forms, either as an atrophic or developmental change. In the former, the bone becomes rapidly decalcified and thinned in patches; in the latter, 'bosses' of new bone are formed on the outer table, producing elevations, which are sometimes known as 'Parrot's nodes,' as they were first described by Parrot.

When the bones become thinned the condition known as 'cranio-tabes' may be produced. This condition is characterised by a peculiar crackling from extreme thinning of the bone; or sometimes the bone may entirely

disappear, leaving only a softened patch in some part of the vault of the skull. These patches are generally situated in the occipital region, and are believed to be due to the pressure of the child's head against the pillow or nurse's arm, and this pressure, acting on the softened bone of the syphilitic child, produces the thinning and the consequent cranio-tabes. This is rendered the more probable from the fact that this condition is rarely met with at birth, but usually appears from some weeks after up to the twelfth month. Softened patches may be found in other situations, as on the parietal bones. Cranio-tabes and Parrot's nodes may co-exist in the same skull. In the bones of the extremities infants affected with congenital syphilis frequently suffer very early in life from a peculiar form of inflammation at the line of union between the shaft and epiphysis. This is often followed by disjunction of the epiphysis from the shaft, and sometimes suppuration. Occasionally a premature union takes place between the epiphysis and shaft, resulting in a stunted limb. The disease bears some resemblance to rickets, but may be distinguished from it by the earlier appearance of the syphilitic lesions, the absence of the prodromata of rickets, the presence of other syphilitic symptoms, the rarity with which the ribs are involved, the history of the case, and the effects of treatment. Later on in the life of a syphilitic child, the bones may become affected with osteitis and periostitis, leading to sclerosis with elongation of the bone, or to caries. These conditions will be considered in the section on DISEASES OF BONES.

The later manifestations of inherited syphilis are shown in the eye, in the teeth, the auditory apparatus, and the general appearance of the child. They generally appear about the age of puberty, but may reveal themselves much earlier, even as early as five, or may be delayed in their appearance until adult life. The affection to which the eye is liable has been described by Mr. Hutchinson as 'interstitial keratitis,' in the following words: 'Chronic interstitial keratitis usually commences as a diffuse haziness near the centre of the cornea of one eye. There is at this stage no ulceration, and exceedingly slight evidence of the congestion of any tunic. The patient, however, almost always complains of some irritability of the eye, as well as of dim sight. If looked at carefully the dots of haze are seen to be in the structure of the cornea itself, and not on either surface; they are also separate from each other, like so many microscopic masses of fog. In the course of a few weeks, or it may be more rapidly, the whole cornea excepting a band near its margin has become densely opaque by the spreading and confluence of these interstitial opacities. Still, however, the greater density of certain parts—centres, as it were, of the disease—is clearly perceptible. Early in this stage the comparison to ground-glass is appropriate. There is now almost always a zone of sclerotic congestion and more or less intolerance of light, with pain around the orbit. After from one to two months the other cornea is attacked and goes through the same stages, but rather faster than the first.' Under appropriate treatment restoration to transparency is often complete, though sometimes patches of haziness may remain for the rest of the patient's life. The affection of the teeth is only seen in the permanent ones; the temporary teeth, though they may necrose or decay earlier than usual, show none of the characteristic changes. The condition is believed by Mr. Hutchinson to be the effects of stomatitis merely;¹ so that if a syphilitic infant escapes stomatitis his teeth will not be irregular; and there-

¹ 'Path. Soc. Trans.' vol. ix. p. 449.

fore the non-occurrence of this dental irregularity is no proof of the absence of syphilis, though its presence is a strong confirmation of the diagnosis. The syphilitic characters are most marked in the median upper incisors (the 'test' teeth), but may also be observed in the upper lateral incisors or in both lower incisors. These teeth will be found to be small or dwarfed; their cutting edge narrowed and notched so as to display a deep groove on their edge, or two grooves with a central projection (Fig. 185). There are various deformities of the teeth, due to other kinds of stomatitis (classed as mercurial, and due, as is believed, to the abuse of mercury), which require to be distinguished from the syphilitic deformity. The main diagnostics are that the mercurial form chiefly affects the first molars, and causes transverse pitting of the enamel over a great part of the surface of the teeth affected. Many children the victims of inherited syphilis become deaf, without any appreciable cause; the deafness, as a rule, affecting both ears; generally, however, one ear becoming affected before the other.



FIG. 185. Syphilitic teeth.—From a paper by Mr. Jonathan Hutchinson, 'Path. Soc. Trans.' vol. x. p. 296.

The general appearance of a child afflicted with congenital syphilis is characteristic. The forehead presents a rounded, prominent form, with a horizontal groove above the eyebrows. The nasal bridge is depressed and sunken. At the angles of the mouth are often seen radiating scars. There is frequently an idiotic expression and, accompanying this, mental deficiency, sometimes amounting to true idiocy. These symptoms, together with the haziness or opacity of the cornea, the unexplained deafness, and the incisor-teeth test, render the diagnosis absolutely certain without the confirmatory evidence of the history of the child as regards the earlier manifestations of the mother as regards miscarriages, &c., which, however, are valuable confirmatory symptoms.

Treatment.

The treatment of congenital syphilis is extremely simple. Mercury is urgently indicated, and there is no remedy so successful. There is no necessity for giving large doses—in fact, they are not well borne by the bowels—nor, indeed, is there any need to administer mercury by the mouth at all. The old plan recommended by Brodie answers admirably—to make the child wear round its arm or belly a piece of flannel, about two inches wide, smeared with 'blue' ointment; or, if this irritates, the oleate of mercury ointment may be substituted. The objection to this plan is that ignorant people think 'nothing is being done' for the child, and consequently are very liable to neglect the use of the ointment. In such cases, a grain of grey powder with two or three grains of compound chalk powder may be given three times a day, though it is a little apt to purge. If the mother shows signs of marked syphilis, I am of opinion that it is better to bring the child up by hand rather than let it derive its nourishment from the vitiated source of its mother. Some, however, recommend that the mother should be treated with mercury so as to benefit both. On no account should the child be put to a wet-nurse. Many cases are on record where the nipple of the nurse and subsequently her own child have been infected in this way. Beyond this no other treatment is needed except cleanliness, and, if the obstruction of the nose is so extreme as to constitute an impediment to suckling, constant cleansing of the nostrils by gently syringing with an alkaline solution.

Under this treatment the disease is seldom dangerous ; nor, indeed, is congenital syphilis, as far as I have seen, often fatal directly ; but many syphilitic infants die, in consequence of the cachexia, being too weak to resist any inter-current disorder.

We ought not to quit the subject of congenital syphilis without noting the important observation of Mr. Hutchinson, which seems to be supported by other experience. that healthy women may be infected with secondary syphilis by carrying syphilitic children. In such cases there is, no doubt, some difficulty in determining whether the woman has been infected directly from her husband or indirectly from her child. The test is, of course, the occurrence or non-occurrence of primary syphilis ; but this may easily have been overlooked.

There is no doubt that syphilis is inoculable in the secondary as well as in the primary stage—in fact, one of the forms of secondary syphilis (the mucous tubercle) yields a secretion which is often very contagious—but other secondary sores may be communicated, though their contagion is less active than that of the primary sore, so that it requires a longer contact in order to act, and takes a longer time to develop its effects. But it must be recollected that the effect of the inoculation of syphilis anywhere, whether primary or secondary, is to produce a chancre on the part inoculated.

Noncon-
genital
syphilis in
infants.

This appears to be the usual cause of the non-congenital form of syphilis in infants. In countries where wet-nursing is common it appears to be not very unusual for an infant when nursed by a syphilitic woman to contract the disease, either from secondary ulcers on the nurse's nipples, or from contact between some accidental abrasion on any part of its body and some sore on the person of the nurse. In the former case the chancre will be on the lip, and the bubo which also accompanies it will be in the glands under the jaw ; in the latter case the glands next in sequence to the inoculated crack will be affected.

This accidental syphilis of infants is exactly the same disease essentially as vaccino-syphilis, in which the syphilitic poison is inoculated by mistake in conjunction with the vaccine matter. Such cases are rare, but it is impossible to deny that they do occur, although it would appear that a very moderate amount of caution would prevent them.¹

Vaccino-
syphilis.

In vaccino-syphilis the vesicle soon suppurates, and the edges of the resulting sore become hard and chancrous,² the axillary glands soon enlarge and run the ordinary course of the indolent non-suppurating bubo ; the hair then begins to drop off, and eruptions show themselves on various parts ; in fact, the usual train of secondary and tertiary symptoms ensue.

¹ The cautions requisite are well known. They are four in number, viz. : 1. Use a perfectly clean lancet. 2. Take the lymph not later than the eighth day after vaccination, so as to avoid any mixture of pus. 3. Take only lymph—no blood or any other secretion. 4. Examine carefully the child from whom the lymph is taken, so as to be sure that it is not syphilitic. It seems probable that the blood or any other secretion of a syphilitic person may convey the disease, and Mr. Lee believes that the mixture of blood with the syphilitic virus under any circumstances much increases the virulence of its contagion. Hence the desirability of taking lymph only ; but there can be no doubt that most of the instances of vaccino-syphilis were produced by a neglect of the ordinary precautions—1 and 4 above.

² 'The conveyance of syphilis by vaccination is never effected without the intervention of the vaccination-chancre.'—Hutchinson's 'Illustrations of Clinical Surgery,' p. 113. Here the reader will find portraits of the vaccination-chancre contrasted with other unhealthy conditions of the vaccine vesicle, together with many details for which I cannot find space.

Other
irregular
forms of
syphilis.

Another manner in which syphilis may be communicated remains to be mentioned ; and that is, amongst Jewish children in the operation of ritual circumcision. Not long since a group of cases occurred at the London Hospital in which primary syphilis had been communicated to infants by ritual circumcision ;¹ and a short time ago I had an infant under my own care in St. George's Hospital in which the disease had been communicated in the same way, and which terminated fatally.

The treatment of these unusual instances of syphilis is exactly the same as that of the common disease ; but their exceptional character renders the diagnosis somewhat difficult, as it is also in the irregular chancres that occur in adults. Such chancres are most common either on the lip or on the finger. A chancre on the lip does not present exactly the same appearance as it does in the genitals. It is generally much larger and flatter, and there is less induration around it ; but its indolent appearance, flat surface, and accompanying bubo in the glands beneath the jaw will generally indicate its nature to a practised eye ; and if there be much doubt, a few weeks' delay will usually prove the existence of syphilis by the appearance of a secondary eruption. Chancres on the fingers are still harder to diagnose. In fact, the natural action is interfered with in these exposed parts by the constant irritation to which the sores are subjected. But in doubtful cases the effect of mercury generally settles the question, by producing the rapid subsidence of the sore and disappearance of the bubo. I have seen many instances of this in supposed epithelioma of the lip.

It remains to say a few words on the question of marriage after syphilis. The subject is a difficult one, but of great importance. To extend the time too long prevents many marriages, and does not tend to check the spread of the disease ; but, on the other hand, the welfare of a woman and her offspring depends on the decision. There can be no doubt that the disease can be transmitted during the whole of the time that secondary symptoms are present, and the same may probably be said to be true of those intermediate conditions which precede the tertiary stage. But in the tertiary stage itself there is good reason for believing that contagion is not possible and that the parent does not infect his offspring. Mr. Hutchinson tells us that for twenty years he has sanctioned the contraction of marriage after two years from the date of infection, when the patient has been thoroughly and successfully treated with mercury, and that he has never seen any reason to regret the adoption of this rule, and has met with ill-consequences in but one case. Perhaps this is as good a general rule as can be laid down, though subject to modifications according to the particular circumstances of the case. It can be very rare, indeed, that instances will occur in which it is safe to allow a patient to marry at an earlier period than this.

¹ 'Lancet,' 1888, vol. i. p. 171.

CHAPTER XXI.

ULCERS. CICATRICES, AND THEIR DISEASES.

THE process of ulceration has been described in a previous chapter (see p. 42). When this process has gone on for some time around a wound, so that it has spread to a large size, or when, as is more commonly the case, a slough has formed and come away, the granulating surface which is left is called an *ulcer*, and it maintains this name till the healing process has been completed and the whole is filled up and converted into a *scar*.

The matter which is furnished during the ulcerating process varies in character according to the nature of the ulcer, being sanious or foul, ichorous, contagious,¹ &c., approaching more and more nearly to healthy pus as the healing process advances. The distinctive characters of ulcers depend on differences observed in the base, the granulations and the pus which they secrete, the edge, and the parts surrounding the ulcer.

Ulcers are divided into classes (I.), according to the constitutional causes on which they depend, and (II.) according to the local characters which they present.

I. With reference to the constitutional causes which modify the character of the ulcer, the following varieties are described:—

1. The *simple* or *healthy* ulcer, such as that which follows accidental injury in a healthy person. Its base is level and slightly depressed. The granulations are florid, uniform, small, soft, elastic to the touch, vascular, but not usually bleeding spontaneously, and not highly sensitive; the edges shelve gently, are not peculiarly hard, and are of an opaque white at the circumference, where the epithelium is condensed and heaped up, shading off into a thin, bluish-white, glistening film which becomes gradually lost on the granulations; the pus is healthy or ‘laudable.’

Healthy
ulcer.

This form of ulcer will heal under the simplest treatment, or, in fact, under no treatment at all, if defended from all irritation or congestion. If the patient is obliged to go about, the ulcer should be protected from congestion by strapping and bandage. This is most thoroughly done by the plan called Baynton’s. The limb is encircled with strips of strapping, each lying half over the one below it, and all crossing in front, from an inch below to as much above the ulcer, and is evenly bandaged from the foot to some distance above the sore.

The use of Martin’s india-rubber bandage as a substitute for the old plan of strapping has now become very common; and it has the advantage

¹ The specific characters of pus have not been much studied, but we sometimes see the inoculability of matter tested in the case of ulcers or sores presumed to be syphilitic and in cases of gonorrhœal ophthalmia. Pus from a soft sore will excite a specific action, reproducing a similar chancre for a great number of times. The inoculation of ordinary pus, on the contrary, only causes a little pimple, which soon disappears. So with gonorrhœal matter. Pus taken from a case of acute gonorrhœa and placed in the conjunctival sinus will excite the most acute inflammation, often rapidly destroying the eye, while pus from an ordinary abscess will only cause a slight and transient inflammation, and often none at all. This may be, and probably is, due to the presence in the pus of a micro-organism.

of being a much more simple application, and one that the patient, if an intelligent person, can apply for himself. But in order to succeed it must be very carefully and evenly applied, and the most scrupulous cleanliness must be enforced. For want of these precautions I have often seen this bandage do harm.

Inflam-
matory ulcer.

2. The nearest to healthy ulcers are the *inflammatory*. They are usually single and small; the skin around is hot and red, often œdematous, with burning pain in the part. The base is level and little depressed, but ragged and flocculent; the granulations are generally absent, so that the base looks raw; it is ruddy in colour, or ash-grey, or yellowish, with thin adherent sloughs. The edges are abrupt, irregular, or shreddy. The pus is ichorous, thin, watery, excoriating the edges, and frequently bloodstained.

In the treatment of such ulcers the main point is to subdue the inflammation by rest in the raised position of the limb, with warm soothing applications, such as warm Goulard-water Oss., tinct. opii ʒj., on a thick, soft rag or compress of lint covered with oiled silk. In some cases benefit seems to accrue from applying leeches at a distance.

The patients are often gouty or habitually intemperate. If so, purging is indicated, with the addition, in the gouty subject, of a little colchicum; sometimes they are weak and require tonics and support.

Eczema-
tous ulcer.

3. The *eczematous* resemble the inflammatory ulcers, but are complicated with eczema of the surrounding skin. The constitutional condition which is the remote cause of the eczema must be discovered and treated—whether it be gout, struma, or other cachexia—and the eczematous skin must be treated as well as the ulcer. Wet applications rarely agree with the eczematous ulcer. They will be found to heal most readily under the use of boracic ointment, to which a little extract of belladonna may be added, or the skin dusted with equal parts of oxide of zinc and starch, or washed over with nitrate of silver lotion. Nayler recommends an ointment of red precipitate of mercury, 5 to 10 grains to the ounce, covered with a compress of linen wrung out of hot water.¹

Occasional
harm from
healing an
ulcer.

Paget says: 'It is probably these more than any other ulcers that have given rise to the question whether ulcers should always be cured if possible. There is sufficient reason to believe that the cessation or cure of an established eczema has been attended with serious disease of the brain or other internal organ; the same may happen with an ulcer of this or probably some other kinds. The event is certainly very rare, but it may often be right to guard against it by making an issue in some place more convenient than the ulcer, or by renewing the cutaneous disease by counter-irritants.'

Ulcers similar to the eczematous are met with in other constitutional eruptions.

Strumous
ulcers.

4. *Strumous* ulcers are such as occur in strumous subjects, usually in combination with other local symptoms. They often follow on suppurating glands or softening of subcutaneous masses of tubercle, as evidenced by the presence of small nodular masses, which soften, with a low inflammation of the skin over them. They are often multiple, the individual ulcers being originally small and oval, but afterwards coalescing into irregular shapes. They are found most frequently in the situation of the lymphatic glands, i.e. in the neck and groin, and are frequent on the face and head; but they do also occur on the limbs. The base is soft, unequal in level; the granulations are large, pale, soft, œdematous, often exuberant, and bleed easily; the pus

¹ See the chapter on Eczema in Nayler's 'Diseases of the Skin,' 2nd ed.

is thin, greenish yellow, and possibly curdy; the edges are undermined, pale pink or purplish, with overhanging, thin, or irregularly hardened skin, and there is often a warty growth of the papillæ around (particularly in the hands and feet), which, combined with the other characters of the edges, gives some resemblance to epithelioma; but strumous ulcers want the hard base, sinuous raised border, and rapid progress of cancerous ulcers. There is seldom much pain, though where they have existed long the parts around become œdematous.

The edges often require to be destroyed with caustic potash before the sore will heal.

The general treatment of struma must be pursued, and the ulcers locally stimulated with iodine in the form of ointment, or of lotion applied on linen strapping, or with nitrate of silver lotion. Their scars are often causes of deformity, either by contraction or by overgrowth, which is more frequent, and which must be combated by repeated slight blistering.

Very deep, obstinate, and extensive ulcers may justify amputation, particularly when situated near the ankle, and when any neighbouring joint or bone is simultaneously affected. I am anxious, however, to call the reader's attention to the great benefit which often results in these and in most other of the less healthy forms of ulcer from the free removal of the ulcerating surface with some raspatory, such as Volkmann's spoon, followed by the unsparing application of the actual cautery. When the cauterised parts have come away a more healthy surface is left exposed, and will often begin to granulate healthily; so that by appropriate treatment, skin-grafting, &c., it may be brought to heal. I have thus treated almost all forms of unhealthy ulcers—syphilitic, callous, lupous, and even one which was judged both on naked eye and microscopical examination to be epitheliomatous—with the happiest results. In some of the cases the fasciæ, the tendons, the periosteum, and even the bones were freely exposed, and in one remarkable case the man was admitted on his own request in order to have the leg amputated.

5. *Scorbutic* ulcers are those which accompany scurvy, and derive their peculiarities from the effusion on their surface of the same semi-organised plastic material which occasions the swelling of the gums, the intermuscular swellings, and the vibices and petechiæ of scurvy.

Scorbutic
ulcers.

The ulcers are livid, with irregular, swollen borders, their surface covered with a dark, spongy, fœtid crust, which adheres so strongly that its removal causes free bleeding, and which is rapidly reproduced. The treatment must be directed to the constitutional disorder. When this is removed the ulcer becomes of a simple nature.

6. Gouty persons often suffer from inflammatory or eczematous ulcers, but the proper *gouty ulcer* is that which is found over gouty deposits or in parts distinctly gouty, and it usually involves only part of the thickness of the skin. The base is florid, the granulations absent, or greyish or yellow, the edges low and shelving, the pus thin and ichorous, frequently leaving a white chalky deposit. The ulcers are very indolent, 'exceedingly slow in getting either better or worse.'

Gouty
ulcers.

The treatment here again is directed to the disorder of the constitution. The local treatment is limited to water-dressing, simple cerate, or weak solutions of nitrate of silver.

7. *Syphilitic* ulcers are those which form on the skin in secondary or tertiary syphilis. They are situated usually on remote parts, but the genital

Syphilitic
ulcers.

organs may also be affected with secondary sores, and it seems certain that the matter from such sores is contagious.

Secondary ulcers are much more rare than tertiary. They generally proceed from the sloughing of parts affected with pustular eruptions in cachectic persons.

Tertiary syphilitic ulcers 'usually appear among the latest signs of syphilis, and are most severe in those who are most reduced, whether by the syphilitic poison abiding in them or by mercury, or by both, or by poverty, intemperance, or naturally unsound constitution. There is probably no form of ulcer in which the influence of all these evils is more intensely felt.'

Tertiary ulcers are divided into two forms; not, however, generally distinguishable at a late stage: (a) the *superficial*, which follows on rupia or some other ulcerative eruption, sometimes, though not usually, commingled with such eruption. These are best known by the annular or horseshoe form spreading from the exterior, while healing from the inside (*serpigo*), and are often multiple, arranged in some circular or curved figure. Their local characters are not otherwise very decisive, and the diagnosis is made from the history or concomitant symptoms. Sometimes the discharge is heaped up into scabs resembling those of rupia. These ulcers have usually no induration, and often do not penetrate the whole cutis.

(b) The *deep* tertiary ulcer usually commences in the softening of a subcutaneous gummatous swelling, over which the skin gives way, leaving a circular sore, which looks as if the skin had been punched out. The base of the sore is often found sloughing. The sore is at first surrounded by a ring of induration, which is gradually destroyed and falls into the ulcer. There is often an area of dusky redness round the ulcer, which forms a contrast to the pink halo already described as surrounding the strumous ulcer. Tertiary ulcers may extend to any depth, through the fascia to the muscles, periosteum, or bone. They occur in late stages of syphilis, often with no other syphilitic symptoms, though in other cases otitis or periostitis may be present elsewhere. Frequently the diagnosis can only be made by the effects of specific treatment. In ulcers situated on the leg it is useful to remember that the simple and the varicose ulcers generally occur on the inner aspect of the limb, a little above the malleolus, and are usually single; while the syphilitic ulcers occur more often on the outer side, and are commonly multiple, very often appearing simultaneously on both legs, and sometimes are nearly or quite symmetrical on both.

Specific treatment is usually of no use so long as the ulcer is inflamed; but when by rest and soothing applications all inflammatory complications have been subdued it generally succeeds rapidly. The iodide of potassium, in full doses of gr. v.-viiij. or x. three times a day, usually procures the speedy healing of the ulcer, which, however, in many cases soon breaks out again. For permanent cure a course of mercury is generally necessary, and it is best administered in the form of a calomel vapour-bath, either applied to the whole body, with some mercurial ointment or lotion to the part, or in the form of local fumigation; and in that case smaller doses of the salt suffice: about 5 grains, in a small lamp surmounted by a tube, with a mouthpiece fitting the sore, will usually be enough, if applied every night so long as the sore is open, and followed by a somewhat larger dose up to the end of six weeks, the quantity being regulated by the state of the gums.

8. *Lupous* ulcers are characterised by the precedence of the tubercles of lupus, which, however, perish in the ulceration. They are more common on

the face than on any other part, and particularly the alæ of the nose, where the skin joins the mucous membrane, and are frequently accompanied by perforating ulcers of the septum nasi or in the pharynx. They sometimes occur in young persons of strumous constitution. The base is pale, and in some cases level, but in others covered with coarse, dusky, prominent granulations, raised highest at the centre of the sore. The borders are abrupt, irregular, eroded, and sometimes slightly raised and thickened. As long as it is spreading small soft characteristic tubercles are to be seen in the neighbourhood; the pus often scabs on the surface. The ulceration slowly extends at the margins and beneath the scabs till it perforates the parts below, as the cartilages and bones of the nose, the mucous membrane, &c., though still without pain. As it spreads in one direction it cicatrises in another, leaving a thin scar, which is very prone to break down again.

These ulcers are sometimes allied to struma, of which other symptoms may be present, and the general treatment is the same; but they are seldom got to heal without destroying the surface of the ulcer. This is best done by scraping the whole of the surface and applying one of the powerful caustics, as potassa fusa or acid nitrate of mercury. Other forms of lupus are, however, frequently met with—the lupus nonexedens, and the erythematous, for the description of which I must refer the reader to the chapter on SKIN DISEASES or to special works on the subject.¹

The contraction of lupous ulcers, especially around the mouth, or the orifice of the nose, or near the eyelid, gives rise to deformity, which is best treated when it assumes the form of an annular constriction by gradual dilatation with sea-tangle tents or ivory wedges, and, in case of ectropion, by a plastic operation which will be found described in the text-books on Ophthalmic Surgery.

9. *Rodent* ulcer was formerly classified as lupus, but it occurs later in life; the latter, like strumous affections, is more common in early years. Rodent ulcers occur most commonly on the face and head, though they are found also on the female organs of generation and breast, as well as in other parts. They spread gradually, with little acute pain, but sometimes with constant aching, destroying all the parts with which they come in contact, so as sometimes to remove every feature of the face.² They are therefore sometimes classed with the cancers;³ but they infect merely by continuity of tissue not attended with glandular disease or with deposit in remote parts.

Rodent
ulcers.

It always commences in the skin, and generally as a small wart, which ulcerates in its centre. It invades all structures, and its progress is at first slow; when, however, it reaches and attacks the bones, the ulceration appears to be more active, and it is especially destructive to this tissue. It has a tendency to imperfectly cicatrise in one direction whilst it spreads in another.

¹ See especially three lectures delivered by Mr. Jonathan Hutchinson before the Harveian Society during the session 1887–88.

² See a preparation at St. George's Hospital Museum (Ser. xvi. No. 57), in which the patient lived for a long time with every feature of his face removed, except one eye, the eye and the tongue being in the same common cavity.

³ An interesting little work was published in 1867, 'on Rodent Cancer,' by the late Mr. C. H. Moore, which is well worth reading. Mr. Moore, however, clearly distinguishes between the local malignity of rodent ulcer and the constitutional infection of cancer; in fact, the main object of his book is to show the possibility of eradicating rodent ulcer permanently by adequate surgical operation.

The edges of rodent ulcers are slightly raised, and somewhat tubercular, or smooth, hard and rounded. In rare cases they present a warty, lobed mass like epithelioma. Their base is tough and hard, smooth, yellowish red, half-dry, and glossy; generally devoid of granulations, though occasionally little patches of granulations may be seen here and there studded over the surface. In its histological character the rodent ulcer is probably indistinguishable from epithelioma, except perhaps in the fact pointed out by C. Warren, that the cells of the growth, which are evidently epithelial, are very much smaller than in epithelioma. Mr. Butlin¹ thus describes the microscopical appearances of rodent ulcer. 'Masses or groups of cells, in alveoli formed by fibrous tissue, . . . the cells smaller than those of the surface epithelium, and resembling rather in size and form the cells of the root-sheaths of the hairs. They are so closely packed that no intercellular substance can be seen between them. . . . Scattered among the central cells, cell-nests or epidermic globes can often be distinguished.' Thus the resemblance to epithelioma is very marked, and the two diseases can only be distinguished from each other by their clinical characters. In rodent ulcer there is an entire absence of glandular enlargement; there is a very small amount of new growth in comparison to the amount of ulceration; the rate of progress is very much slower; the ulceration has a tendency to cicatrise in places, which epithelioma never does; it does not usually occur in the same situations as epithelioma. By these differences the one disease may usually be diagnosed from the other, though, no doubt, in the early stage the distinction is very difficult.

The most perfect general health is quite compatible with the most extensive destruction of the tissues by rodent ulcer. In the case referred to in the footnote on the preceding page the patient lived for years in good health with almost the whole face destroyed, and then died of old age. Further, it has been abundantly proved that if the parts concerned in the rodent ulcer be entirely removed, so that nothing but healthy parts are left, the patient may live for an unlimited period without the return of the disease. In other cases, however, it has returned, probably on account of incomplete removal.

The indication, therefore, is to remove the disease thoroughly and completely, and this is best done by a combination of the knife and caustics. All the visible ulcer having been cut out freely, the part should be left for a day or two till the bleeding has quite ceased, and then an active caustic, such as the chloride of zinc, spread on lint, is to be freely applied to the exposed soft parts. If the bones are implicated they must be soaked in strong sulphuric acid until they come away. I well remember seeing at the Middlesex Hospital a case which had been thus treated with success, in which a great part of the side of the face and one eye had been removed, and the neighbouring part of the base of the skull, so that in looking into the gap the pulsation of the brain was perceptible over a large surface. The hiatus in the face had been cleverly filled up by a mask of vulcanite painted to resemble the natural features.

Cancerous
ulcers.

10. *Cancerous* ulcers occur either from the adherence of the skin to a cancerous mass or from the deposit and softening of cancer in the skin itself. Those which commence in the skin are of the epithelial variety.

The edges of cancerous ulcers are raised and everted, hard, nodular, and warty. Their granulations are coarse, uneven, deepest in the centre of the sore, and they bleed spontaneously; the base is hard, nodular, and surrounded

¹ Syst. of Surg.' 3rd ed. vol. i. p. 154.

by the cancerous deposit; the pus is foul and ichorous. There are often enlarged glands or other cancerous deposits in the neighbourhood.

It is sometimes of importance, and especially in tumours of the breast, to distinguish the ulceration produced by a cancerous tumour from that which may be caused by any other formation.

The main sign is that cancerous tumours cause ulceration by infiltrating the skin with cancer, which then breaks down, while innocent tumours cause ulceration by pressure only. Therefore, in the latter case, besides the absence of all other signs of cancer, it will be noticed that the skin is merely thinned, and retains its perfect softness and flexibility even up to the edge of the opening.

The treatment of cancerous ulcers consists in removing the whole part on which they are situated, whenever that is possible. In parts which do not admit of amputation the skin around the ulcers may be freely cut away, and in some instances a healthy cicatrix will be obtained, and the disease at any rate temporarily checked. If this also is impossible, only palliative treatment can be adopted in most cases—i.e. some application which will keep the wound clean, and a sufficiency of opium or other narcotic to allay the pain—though there is no objection, if the disease has not gone too far, to the removal of the ulcerated surface with some powerful caustic, of which the sulphuric acid made into a paste with asbestos seems the least painful. This treatment, indeed, can only be regarded as palliative, for the disease is almost sure to return soon, even if the caustic should succeed in removing it for a time.

II. The following varieties of ulcer depend on local conditions:—

11. *Varicose* ulcers are such as are occasioned by the pressure of the blood in varicose veins above, rendering the skin congested and prone to low inflammation. These ulcers are of the ordinary chronic, inflammatory, or eczematous kind, and are situated usually above the inner ankle. Well-regulated pressure, and the maintenance of the elevated position of the limb, are necessary adjuncts to the ordinary treatment above described; or the veins may be obliterated by operation (see the chapter on DISEASES OF VEINS). Tonic medicines are indicated, and opium is useful where there is pain or inflammation.

Varicose
ulcers.

12. *Edematous* or *weak* ulcers are such as occur on œdematous limbs, and the granulations of which are œdematous from partaking of the general œdema, or from being constricted by a neighbouring scar or by tense skin. The remedies are to reduce the œdema, to apply astringents to the granulations, to strap and bandage the ulcer and the whole limb below it; or, in some cases, to divide the constricting medium.

Edema-
tous or
weak
ulcers.

13. *Exuberant* ulcers are those in which the granulations project considerably beyond the surface, but are free from any cancerous deposit. In such cases the general health must first be carefully attended to, free purgation being usually necessary. The granulations are to be repressed by pressure and by the light application of stick-caustic.

Exuberant
ulcers.

14. *Hæmorrhagic* ulcers are such as bleed from a great variety of causes; bursting of varicose veins and venous congestion are the common causes. Phagedænic and cancerous ulcers often bleed spontaneously. Vicarious menstruation and ulceration into a bloodvessel are other but much rarer causes of bleeding.

Hæmor-
rhagic
ulcers.

The appropriate treatment is involved in the discovery of the cause.

15. In *neuralgic* ulcers the pain generally depends on some unhealthy

Neuralgic
ulcers.

condition of the ulcer or on some local cause—true neuralgia attacking an ulcer is much rarer. The remedy is to cure the ulcer, for which purpose its division is often indicated. The painful ulcer of the anus is an example; but painful ulcers of the legs are often also brought to heal by complete division, under anæsthesia, the knife being carried through their whole extent in various directions.

Inflamed
ulcers.

16. *Inflamed* ulcers are distinguished from the ‘inflammatory’ described above, in that the inflammation in these depends on a local irritation, while in those it is part of a constitutional condition.

In inflamed ulcers there is an increase of pain, with redness and œdema around them—the discharge is copious and bloody; the granulations become swollen and congested, and then slough; the edges are often abrupt or jagged. Such inflammation occurring in a callous ulcer is often curative, as in the treatment by blistering, or the inflammation excited by erysipelas.

The indications of treatment in an inflamed ulcer are to remove any source of irritation, to apply soothing warm lotions, and to enforce rest.

Callous or
indolent
ulcers.

17. The *callous*, *chronic*, or *indolent* ulcer is usually situated on the leg, with its long axis parallel to that of the limb. Sometimes it encircles the leg. Its base is deep, flat, pale, or tawny, and adherent to the deeper parts; the granulations are very small; the edges raised and callous, with heaped-up white epidermis; the pus is thin and often offensive. The kinds of ulcer thus modified are usually the syphilitic, inflammatory, and eczematous; but any kind of ulcer may become chronic, and when a specific ulcer does so the specific treatment ceases to be efficient.

The most effective plan of treatment is by blistering—a common blister applied over the whole sore and its edges often sets up an inflammatory action, which leads to cicatrisation, and removes the heaped-up epidermis, which seems to interfere with the healing of the edges. It is not very painful, and the epidermal tissues, or their scar-like islands, which the blister may remove from the surface of the ulcer, are of no real value in closing the sore. Slighter cases may be brought to heal by strapping and bandage, with some exercise of the limb; and opium internally seems often of service. In the more advanced cases incisions may be made through the ulcer and through its base well into healthy parts on all sides. And there are callous ulcers which cannot be brought to heal, and in which amputation may be justifiable.

18. Phagedænic ulcers have been already treated of (p. 68).

Cicatrices
and their
diseases.

The healing of an ulcer produces a scar or cicatrix. The process has been described above (p. 43); and when the scar-tissue remains permanent, although the scar is ugly and of a lower organisation than the natural parts, yet it causes no important inconvenience. But the imperfect vascularity of scars, their low and abnormal growth, and the absence from them of the sebaceous and sweat glands which lubricate the natural skin, render them peculiarly liable to various diseases and degenerations, which it will be convenient to describe briefly in this place.

Ulceration
of scars.

The most common surgical complication of a large scar is its breaking down and ulcerating—a very common event in deep and extensive scars.¹ Such ulcers are slow to heal, and are very prone to recur, so that often, when the scar is seated on a limb, amputation becomes necessary.

¹ ‘Of all scars,’ says Sir J. Paget, ‘none are so ready to ulcerate as those that adhere to bones; and the ulceration may happen twenty or more years after their formation.’

The scars of large burns are peculiarly liable to this degeneration, which is best combated by attempting to implant fresh tissue in the sore by means of skin-grafting. Grafting, however, will not, in all probability, prove successful until some healthy action has been set up in the part, which may be affected by some active stimulant, as iodine, brushed over the part, in increasingly strong solution, or perhaps pure; or blistering fluid; though before making trial of such powerful irritants it is well to try the gentler stimulus of mercurial lotions or some of the balsams. As prophylactic measures against this tendency to ulceration, everything which tends to promote rapid union of the wound may be reckoned, and all possible means should be used to protect large scars from cold and from any accidental friction or violence.

Another common and very distressing affection of scars is neuralgia, or constantly recurring pain. This proceeds sometimes from unknown or constitutional causes, in which case it must be treated like any other neuralgia; in others, from local peculiarity, as from adhesion of a scar to a subjacent bone or from implication of the enlarged ends of nerves in the cicatrix; and such conditions may in some cases be relieved by subcutaneous separation of the scar from the underlying tissues, or by removal of the affected nerve or nerves. Mr. Adams¹ has called especial attention to the possibility of remedying the deformity caused by depressed cicatrices in exposed parts, like the neck or cheek, by freely dividing the subcutaneous attachments of the scar, raising it well from the parts below, and passing needles at right angles to each other under the raised and everted scar, so as to keep it in this position for about three days, after which time the needles may be withdrawn.

Neuralgia
of scars.

A defect which is very frequent in slowly-forming scars (and especially those that follow strumous ulcers) is their excessive formation. Their superficial part is heaped up, cord-like, and very hard, and they adhere in an unnatural manner to the deeper tissues.² This, like every other defect of scars, is best obviated by getting the wound to heal rapidly, if that be possible. Otherwise it becomes very difficult to correct it, the only available means being to reduce it by constant blistering or painting with iodine.

Excessive
formation
of scar.

Closely allied to this is the limited excess of growth by which one or more, and often very numerous, flat rounded tumours are formed on the cicatrix. When such keloid growth is solitary it is difficult to see any difference between it and an excess of scar-formation. But when a number of small scattered tumours occur upon a large scar the distinction becomes apparent. The structure of these tumours is identical with that of the scar, viz. a lowly-organised fibrous tissue, only mingled in keloid with 'cell structures in progress of development, or arrested and degenerate in their incomplete forms,' to an extent which is not seen in merely thick scars. The admixture in these keloid growths of cells in process of development corresponds to the tendency of such growths to increase, and to the irritation which they sometimes cause, and their property of returning after removal, which is sometimes very troublesome. The same remedies as for excessive growth may be tried, but are usually of little avail; and the excision of

Keloid
scars.

¹ 'Brit. Med. Journ.' April 29, 1876.

² Sir J. Paget points out that even after the deepest wounds which can never heal by first intention—such as that of lithotomy—though the scar at first implicates all the tissues for a great depth, yet that ultimately only a thin cicatrix should be left, which, when examined, will be found to be perfectly superficial, and to move as the skin moves over the deep fascia.

the growth is often followed by its return of a larger size, so that it is very doubtful policy to operate, except in cases where the whole part can be removed, and healthy surfaces brought together for immediate union. This can usually be done in the growth which follows occasionally in the lobule of the ear after piercing for earrings, though no such operation should be recommended unless the growth is really of a size to cause considerable deformity, and is on the increase. The keloid of scars differs from the 'true keloid' of Addison in certain particulars, which will be pointed out in the chapter on diseases of the SKIN.

Other
tumours
of scars.

Other forms of tumour are occasionally met with in scars, but the epithelial cancers are the only tumours of much practical importance. They were first minutely and accurately described by Mr. Cæsar Hawkins as 'warty tumours of cicatrices.'¹ The great majority of such tumours are epithelial cancers, and all ought to be regarded and treated as being of this nature, though in some rarer cases it seems that their course is that of an innocent tumour; in fact, a mere collection of large warts growing on the surface of the scar. Such tumours form most commonly on scars of slow formation, as those of burns, and especially on those which used to follow the complicated superficial injuries inflicted in a military flogging. As in other cases of epithelioma, the complete removal of the part affected holds out a tolerably good prospect of permanent recovery, or at least of a considerable period of immunity from return. The glands, as Mr. Hawkins points out, are rarely affected in this form of tumour.

Contracted
cicatrix.

The most troublesome of all the consequences of scarring is the contraction which slowly-forming deep cicatrices are so liable to undergo—a contraction so powerful that it will bind the arms to the trunk, distort the most powerful joints, and even alter the shape of the bones. The worst cases of this deformity occur in the neck, by which the chin is drawn down and fixed upon the chest, all the features of the face are distorted, the shape of the jaw so changed that its body is more vertical than horizontal, and the patient's appearance rendered in the highest degree repulsive.

The best plan in these as in all other progressive disorders is to endeavour to hinder their commencement, or, when this is impossible, to treat them before they become inveterate. In all deep burns, and in all other injuries which destroy the whole skin to any great extent, the greatest care ought to be taken to keep the parts on the stretch during the whole period of union, whenever that is possible. If a scar which has fully formed shows a tendency to contract, that tendency is to be counteracted either by gentle and constant manual extension, the scar being well oiled, and gently but very frequently stretched (which seems to me the best plan when the services of an intelligent nurse or mother can be secured), or by the action of a constant extending force, as a rack-and-pinion apparatus, or a weight. But when contraction is inveterate and very firm, or when mechanical extension is impracticable, some of the autoplasmic operations described in the section on PLASTIC SURGERY may become necessary, for which I must refer the reader to that place.

¹ Med.-Chir. Trans.' vol. xix. 'Contributions to Pathology and Surgery,' vol. i. pp. 149-169.

CHAPTER XXII.

DISEASES OF BONES.

BONE consists essentially of connective tissue, impregnated with earthy salts, and this connective tissue is arranged differently in different parts. On the surface of the bone it is arranged as a fibrous layer, with a deeper layer of cells, forming the periosteum. In the bone proper it consists of a small amount of connective tissue with branched cells in the Haversian canals. In the central canal it is massed together as fat, supported by connective tissue. In inflammation of bone it is this connective tissue that is the seat of the process, which is strictly analogous to the same condition in soft parts. It is necessary to make this observation; for, on account of the continuity of this structure from the periosteum, through the Haversian canals, to the medullary tissue, it rarely happens that the inflammation is limited to one of these structures—the periosteum, the bone proper, or the medullary tissue; and though in the earlier stages the three conditions are clinically and pathologically distinguishable, later on inflammation in one structure is followed by inflammation in another, and all parts of the bone become involved.

It is necessary for purposes of description to keep the three conditions separate from one another and describe them individually. And we shall commence with the description of inflammation of bone proper, or *ostitis*, bearing in mind that this condition rarely exists without the periosteum and medullary membrane being more or less involved.

The first effect of inflammation of bone is dilatation of the blood-vessels, with engorgement and inflammatory exudation and proliferation of the cellular elements lying in the Haversian canals. This is accompanied by a rapid solution and removal of the bone substance, so that the size of the vascular channels of the bone is increased, and at the same time they become irregular in shape and outline. Thus the compact tissue is converted into a kind of cancellous tissue, while the cells of the cancellous tissue are much enlarged, and the bone becomes soft, light, fragile, and much moister than in its natural state. *Ostitis.*

In the microscopic examination of the interior of a bone in an early stage of acute inflammation the vessels in the Haversian canals are seen to be engorged with blood; and numerous round cells, probably emigrated leucocytes, are to be observed in the delicate connective tissue outside the vessel. These cells rapidly increase in number, and soon begin to eat away and destroy the wall of the Haversian canal, so as to form large, somewhat crescentic erosions, which are sometimes called "Howship's lacunæ" (Fig. 186). Sometimes the emigration of leucocytes is so rapid, and the cell infiltration of the connective tissue outside the vessels so great, that, being hemmed in by the rigid bony walls of the canals, they press upon the vessels to such an extent as to occlude them, thus shutting off all vascular supply to the part, and causing death or necrosis of the portion of bone supplied by these vessels. As a rule, however, the emigrated leucocytes erode or eat away the bony walls of the canals, and thus form spaces filled with masses of round cells, and also, in many of them, large cells containing many nuclei; each cell corresponding

to one of the cells of a lacuna (Fig. 184.) These large cells are seen to bear a striking resemblance to, in fact to be tolerably identical with, those giant cells which are found in the marrow of fetal bones, and in myeloid tumours,



FIG. 186. Acute rarefying osteitis. *a*. Embryonic medullary tissue. The osseous lamellæ *b* are irregularly eroded and festooned by ulceration in consequence of the production of medullary cells, as shown at *c*. The preparation was made by acting on decalcified bone with chromic acid. Magnified 100 diameters. From Cornil and Ranvier.

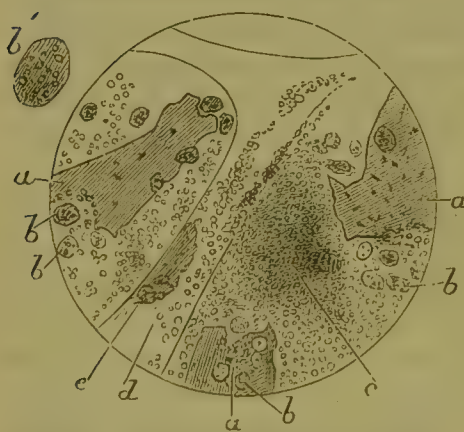


FIG. 187. Portion of a section of bone in a condition of acute inflammation. *a a a*. Bone trabeculae. *b b*. Giant cells—so-called 'osteoclasts'—one of them is shown more highly magnified at *b'*. *c*. Pus-cells. *d*. A vein. *e*. The blood-clot in its interior.

Taken from a patient in whom I amputated the thigh on account of acute supuration in the knee-joint. I am indebted to my colleague Mr. Stirling for the preparation.



FIG. 188. A section from the same case as fig. 187 to show the appearances at the line of junction of the bone and cartilage. *a a a*. Bone trabeculae with the bone corpuscles and giant-cells or 'osteoclasts.' These latter are seen eating away not only the bone-substance, but also the superjacent cartilage at the line of junction. *b*. The articular cartilage becoming calcified. At *b'* are shown the cartilage-cells with the matrix beginning to calcify around them, and staining deep blue with hæmatoxyline. *c*. An artery cut transversely. From a preparation by Mr. Stirling.

and which have been called 'osteoclasts' by Kölliker, from the function which he ascribes to them of dissolving or absorbing the pre-existing bone as the new bone is being formed. Whatever may be thought of this physio-

logical speculation, the presence of similar cells in bone which is undergoing inflammatory erosion has an interesting bearing upon it. In other sections, taken from parts where the bone is in contact with cartilage (Fig. 188), its line of junction is seen to be suffering similar erosion from cells of the same nature, sinking into and sucking out, as it were, the tissue both of the bone and cartilage, the latter of which structures shows the usual traces of inflammation in the neighbourhood. The mode of development of these so-called osteoclasts and their ultimate fate is unknown. Many pathologists, however, believe that they are merely leucocytes that have wandered from the blood-vessels. After the rarefying or destructive process has continued until considerable spaces have been hollowed out around the vessels and filled with these cells, a process of vascularisation sets in. Small loops of blood-vessels project themselves amongst the cells, and a true vascular granulation tissue is formed exactly analogous to the granulation tissue formed in inflammation of soft parts, and which may undergo identically the same changes. The round cells of the tissue become elongated and spindle-shaped, then converted into fibre-cells, and eventually fibrous tissue is formed. But the process, as in the soft parts, does not stop here: the earthy constituents of bone are deposited in this 'scar' tissue (for it is nothing else), and it undergoes a process of ossification, and the inflamed bone, which, as we have seen in the first instance, underwent a rarefying process, and to which the term 'rarefying-ostitis' is sometimes applied, now undergoes a condensing or reproductive process, to which the term 'osteo-plastic ostitis' or 'sclerosis' is given. Sometimes, on the other hand, instead of becoming vascularised and converted into a new structure, the cells of the granulation tissue perish from malnutrition and degenerate into pus-cells, and suppuration in the bone is the result.

Inflammation of bone is generally the result of some injury, or arises from some constitutional cachexia, as syphilis, rheumatism, or scrofula. It generally comes under the notice of the surgeon in its chronic form; the acuter inflammations of bone usually beginning either in the periosteum or medullary membrane, and afterwards extending to the true bone substance. When acute inflammation does attack the bone proper, for the causes pointed out above, it speedily resolves itself into necrosis, under which head it will be considered. Chronic inflammation is usually accompanied by a considerable increase in the density of the bony tissue, so that the thickness of the compact wall is much increased, and in some cases the whole bone is converted into compact tissue, no medullary canals being perceptible; and the density of this inflammatory compact tissue is much greater than that of normal bone—more resembling ivory. The length of the bone may also be much increased, as in simple hypertrophy. The symptoms to which chronic inflammation of bone gives rise are pain of a dull aching character, worse at night, and increased by exercise, or a dependent position of the part; enlargement of the bone, which at first is slight, but becomes greater when the periosteum becomes secondarily involved. The disease is, however, so mixed up with periostitis that it is next to impossible to differentiate the two conditions from each other. Nor is it a matter of vital importance to do so, since the treatment of the two conditions is to a certain point the same. It is said, however, that, as a means of diagnosis, tapping or percussing the bone may be resorted to. If the condition is one of ostitis, a severe pain will be felt to shoot along the bone; while in periostitis the pain is confined to the part struck.

A form of spongy hypertrophy of the bones has lately been described by

Ostitis deformans.

Sir James Paget under the name of Ostitis deformans. In this disease the long bones and the bones of the skull are chiefly affected. They become increased in bulk and distorted in shape. The disease is probably of an inflammatory nature, the Haversian canals being found to contain a tissue closely resembling that found in rarefying ostitis, and to be 'eaten out in a series of curves or concavities with the production of what are called Howship's lacunæ, so characteristic of inflammation.' When removed from the body and macerated the bones are found to be enlarged in all their dimensions, the compact tissue being soft and spongy, and its substance very vascular. The surface of the bone is roughened under the periosteum. This singular disease appears to have no causal connection with any known diathesis, such as rheumatism, struma, or syphilis. It generally begins after middle life, and runs a very slow course, without affecting the patient's general health, nor, indeed, producing any symptoms beyond obscure pains and the deformities due to the bony overgrowths. No treatment which has been adopted has had any influence on its progress.

Leontiasis ossea.

A curious hypertrophy or chronic inflammation of the facial bones has been described by Virchow, and named by him 'Leontiasis ossea.' The disease begins in early life, and consists in the slow and gradual development of osseous masses, partaking of the character of exostoses, and consisting of thickened, porous bone, very irregular and nodular on its surface, which gradually encroaches on the cavities of the skull and face, and produces great deformity. It usually causes death eventually by interfering with respiration or deglutition, or by the pressure of the gradually increasing mass on the brain.

Periostitis.

By periostitis we mean a form of inflammation commencing in the periosteum. It is almost always associated with more or less inflammation of the substance of the bone itself; yet, as it is always spoken of as a separate disease, it may be better for practical purposes so to regard it. Periostitis occurs in two very distinct manners: as simple local periostitis, and acute diffuse or infective periostitis.

Simple local periostitis.

Simple local periostitis is a very common affection, and may involve a considerable area, or be limited to a small extent of surface, when it constitutes the affection called 'Node.' In the former case, where it affects a considerable area, it is usually chronic in its nature, and is really inflammation of the whole bone, with more or less deposit on its surface, which may be perceptible to the hand during life, but in which there is also induration and thickening of the whole bone (see Fig. 189). The symptoms are wearing, aching pain, worse at night, and, after use, heaviness of the limb; possibly some increase of the temperature; little, if any, redness; and irregular deposit on the surface of the bone. The disease is therefore practically the same as that previously described as chronic ostitis, differing from it only in the structure in which the inflammation commenced.

The treatment of the two conditions may be considered together. This consists in giving the part as much rest as possible. If the symptoms, at the onset of the disease, are, as they sometimes may be, somewhat acute in their character, the patient should be confined to bed, with the leg elevated. A few leeches applied over the inflamed part will do much to relieve pain, if this is present. This may be followed by hot fomentation or Goulard-lotion, with opium. If the disease is chronic, the treatment consists in the proper remedies for the constitutional state, if such be present, combined with counter-irritation. But it seems uncertain whether such treatment

has really much specific effect on the disease, though rest and good medical supervision, no doubt, do much for its cure. Iodide of potassium is the drug usually recommended in these cases, as it is supposed to promote the absorption of the new bony material. It may be given in 'five-grain doses' three times a day, and the dose increased if it is judged necessary. Repeated flying blisters to the part is sometimes followed by good results, or the local application of mercury. The best way of applying this is by means of a 'Scott's Bandage' as originally recommended by Scott in chronic disease of joints. The compound mercury ointment, spread on lint, is first applied all round the limb; then two or three layers of soap strapping cut into strips are firmly and evenly applied from some distance



FIG. 189. A internal and B external view of a preparation illustrating the ordinary anatomy of periostitis, from a well-marked example of that disease in the Museum of St. George's Hospital.—'System of Surgery,' 3rd. ed. vol. ii. p. 281.

below to some distance above the inflamed part. Over the whole a starch or gum bandage is to be placed. The pressure of the strapping, together with the support which it affords, and the absorbing properties of the mercurial ointment, frequently have a beneficial effect on the disease. The application must be renewed as often as it gets loose. In those cases of periostitis or ostitis where the pain is severe and is wearing out the patient's strength or prevents his obtaining sufficient rest at night, it is sometimes necessary to make an incision through the periosteum down to the bone, and drill, trephine, or incise the bone with a chisel, according as the operator deems proper. This is sometimes followed by immediate relief, though unfortunately this relief is not always permanent, for as the wound in the bone heals the pain returns with as much violence as ever.

In cases of periostitis where the inflammation is limited to a small extent of surface, the disease constitutes the affection called Node, from the lump or 'knot' (nodus) which it produces on the surface of the bone. Nodes are most common on the most superficial bones, as the cranium, tibia, clavicle, &c. They are formed of thickened and inflamed periosteum, raised up and separated from the surface of the bone by more or less fibrinous effusion. The surface of the bone is also probably inflamed.

Their usual causes are injury, syphilis, rheumatism, and struma.¹

¹ During an attack of typhoid fever, or during convalescence after the fever, patients may be attacked with painful nodose swellings of their bones, which are termed 'typhoid nodes.' They generally occur on the tibia, and usually disappear without treatment, rarely suppurating or ending in necrosis.

The symptoms are pain in the part, increasing when the patient begins to get warm in bed, swelling and apparent softening of the affected bone, which is really due to fluid effused over it. The swelling is usually round and small like a half marble.

If left alone such nodes pursue one of three courses: many are absorbed, i.e. the fluid is absorbed as the inflammation subsides and the swelling disappears; or the inflammatory effusion ossifies and a periosteal thickening of the bone remains permanently; or, finally, suppuration follows, and an ulcerating carious surface is exposed. Syphilitic nodes occur either in the secondary or tertiary stage, and, as may be inferred from what has been said (p. 412), those which are secondary are more prone to resolution or ossification, while the tertiary nodes, like other gummata, are more prone to suppuration and caries.

The treatment of nodes consists in the proper remedies for the general constitutional state, combined with counter-irritation. Iodide of potassium in moderately large doses, combined with opium, certainly seems to relieve the pain both of syphilitic and rheumatic nodes. Five grains of the iodide three times a day may be combined with ten or twenty drops of laudanum, according to the severity of the pain, and the dose may be raised to ten or fifteen grains of the salt if it is judged necessary. There are cases where the formation of a node, especially if the inflammation is severe and suppuration is threatening, is accompanied with so great pain that the division of the periosteum by an incision reaching from one side of the swelling to the other is called for; and this measure often gives instant and permanent relief.

Acute
diffuse or
infective
periostitis.
Acute
necrosis.

Diffuse or suppurative infective periostitis, leading to the condition known as acute periosteal abscess and to acute necrosis, is one of the gravest affections of bone, frequently producing a general pyæmic condition. The disease is usually believed by pathologists in this country to begin as an infective inflammation of the periosteum, which rapidly spreads to the bone and medullary membrane. Many German pathologists, on the other hand, believe that the disease begins in the medullary membrane, and term it infective osteomyelitis. On account of this difference of opinion the term 'acute necrosis' is now very commonly applied to the disease, and appears to be a better one than either of the other two, since it does not imply any theory, but simply points out the constant result of the condition of inflammation, in which all parts of the bone are sooner or later involved. According to Dent, 'the majority of English writers seem to hold that the affection either commences in the deeper osteo-genetic layer of the periosteum or as a superficial ostitis.'¹ Exudation takes place between the periosteum and the bone, and the former becomes more or less detached from the latter. The effusion rapidly becomes converted into pus, which is characterised by containing large quantities of micrococci, even before the abscess has been opened and air admitted. The inflammation and effusion rapidly spread up the periosteum, so that it may become separated from the bone from one end of the shaft to the other, and the whole of the shaft of the bone may lie in a large bag of pus, contained in the separated periosteum. When the inflammation reaches the epiphysal cartilage it usually extends along this and destroys it, and does not extend into the epiphysis or implicate the joint. So that in extreme cases which have been left untreated the whole of the shaft of the bone may become separated from its epiphyses, and, lying in a bag of pus, may undergo complete necrosis.

¹ 'Med.-Chir. Trans.' vol. lxiv. p. 309.

Finally, the periosteum may be destroyed and the pus effused into the surrounding tissues.

The inflammation is evidently infective, for it has a tendency to spread, not only along the periosteum, but through the connective tissue of the Haversian canals to the medulla, which is often seen in these cases to be in a condition of diffused suppuration. Moreover, it is always accompanied by a profound septicæmia, and very often terminates in pyæmia, even before the abscess has been opened. The pus formed between the periosteum and the bone appears invariably to teem with micro-organisms, though no special form has been recognised as the infecting source of this disease.

Acute necrosis is a disease of early life, occurring most frequently some little time before puberty, though it may occur some years before the advent of this period. It is said to be more common in boys than in girls. In a considerable number of cases there is a history of some slight injury to the bone some few days before the appearance of the symptoms, such as a kick on the shin, a blow from a cricket-ball, and such like, which caused a little pain at the time and was then forgotten. It is conceivable that there may have been some slight bruising of the periosteum and injury of tissue so that the micro-organism found a suitable habitat or 'hot-bed' in which to flourish. It occurs most frequently in debilitated children—either those of a scrofulous diathesis, or those recovering from one of the eruptive fevers of childhood, or from some other disease which has reduced the child's condition below par.

The symptoms are very acute, and are ushered in with high fever and great constitutional disturbance—headache, thirst, sickness, diarrhœa, and generally delirium. The temperature is raised to 103° or 104° F. There is intense pain complained of along the course of one of the long bones, especially the tibia, femur, or humerus, which is so great that the child dreads the slightest touch, and even the pressure of the bedclothes is painful. There is swelling along the bone, at first tense and resisting, and evidently connected with the bone. The skin is white and waxy, except, perhaps, sometimes in a subcutaneous bone like the tibia, when it is red and glazed. After a time, if the case is left untreated, the swelling becomes softer, and fluctuation is perceived, and the skin becomes dusky red and œdematous. A soft crepitus may now occasionally be felt at the epiphysial line, and an increased mobility in the continuity of the bone in this situation. The fever still continues, and pyæmic symptoms may set in, even before the abscess is opened, and terminate the existence of the child. The disease is very liable, in the early stage, to be mistaken for acute rheumatism, the intense fever, the acute pain, and the swelling pointing to this affection. If the child does not die from the immediate effects of the disease, death of the whole, or a portion, of the shaft of the bone takes place, and the matter, finding its way to the surface, bursts through the skin or is evacuated by the surgeon's knife. New bone is formed on the internal surface of the separated periosteum, and this forms a new bony cavity, in which the necrosed bone lies loose. This is termed a *sequestrum*, and in the new 'periosteal' bone openings are left, termed *cloacæ*, which communicate by sinuses with the surface of the body, through which pus is discharged.

The treatment of this formidable affection in its acutest forms must be very energetic and decided. A free incision should be made down to the bone as soon as the nature of the case is detected; there should be no delay, no waiting until the presence of suppuration is established. This incision must

be made with the strictest antiseptic precautions, and free drainage provided for. The patient must be supported during the ensuing fever and exhaustion; a sharp watch must be kept for any secondary abscesses, and they must be opened as soon as they are discovered. If the whole of the shaft is separated from the epiphysis and lies loose it should be removed at once; and even if only a portion of the length of the shaft is completely denuded of periosteum and must therefore inevitably perish throughout, it is better to enlarge the opening in the periosteum and saw off the exposed part. In these cases the medullary tissue is generally in a condition of diffuse suppuration; and this proves a source of infection, maintaining the fever and high temperature. The operation is one which I have performed myself and seen my colleagues perform on many occasions; and it is surprising to see how on the removal of the bone the fever subsides and the temperature falls to normal. Satisfactory regeneration of new bone takes place from the periosteum which is left, and all that is necessary is to maintain the limb the same length as the other by means of some appropriate splint and keep the cavity thoroughly drained.

Osteo-myelitis.

When inflammation affects chiefly or entirely the medullary cavity and the lining membrane of the cancelli, the disease is called osteo-myelitis. It may occur either as a simple, non-infective osteo-myelitis, which may be acute or chronic, or as a diffuse, septic, osteo-myelitis, which is always acute.

The simple, non-infective osteo-myelitis always arises from injury, and is not of much clinical importance. In fact, it is a necessary factor in the repair of injury of bone, as after fracture and amputation. It is attended with the exudation of inflammatory products. The marrow first of all becomes of a dark-red colour, then disappears, and granulation tissue takes its place. In the simple fracture, or injury to bone unattended by exposure to air, the granulation

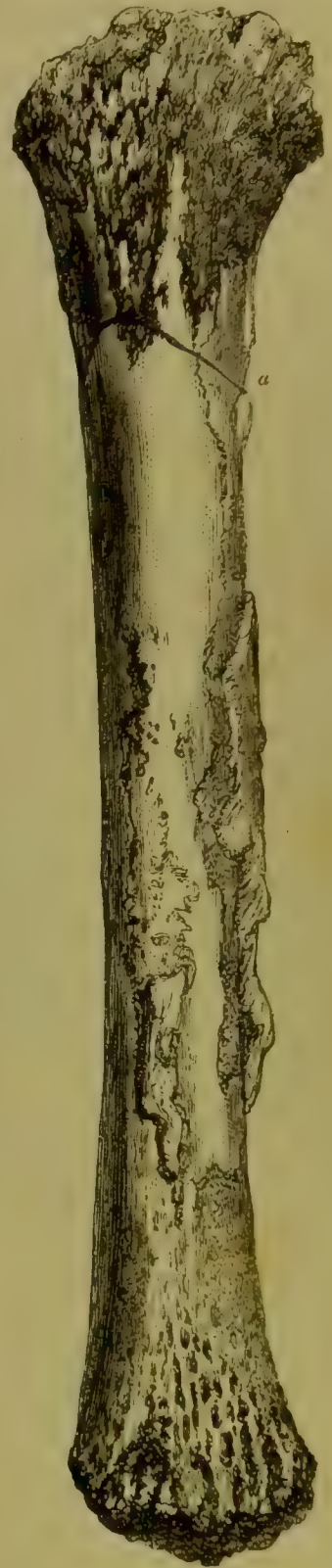


FIG. 190. The entire diaphysis of the tibia, necrosed in a case of acute periostitis. The whole bone was removed by subperiosteal resection a month after the commencement of the disease. (See 'Lancet,' 1866, vol. i. p. 340.) The line (a) indicates where the bone was sawn across in order to remove it. The patient, a boy aged 10, recovered, with perfect use of the limb, which however, was somewhat shortened, and the knee ankylosed.—From Holmes's 'Surg. Dis. of Childhood,' 2nd ed. p. 392.

tissue becomes converted into fibrous tissue, and then bone, forming an 'internal callus.' In the compound fracture and amputation, where the wound in the bone is exposed to the air, the granulation tissue may become converted into pus, and there may be total disorganisation of the internal part of the bone, frequently extending through its entire thickness, and ultimately leading to death of the whole shaft for a variable length. Thus are produced those long tubular sequestra which separate from the femur or other bones after amputation (Fig. 191). This disease requires no active treatment. All that is necessary is to provide for the free exit of discharges, and to wait until the dead bone is felt to be loose, or until the lapse of time renders it probable that it will be found so. Then the soft parts are to be freely dissected off the end of the bone and the sequestrum twisted out with a pair of strong bone-forceps.

Diffuse or septic osteo-myelitis is pathologically identical with the disease above described as acute diffuse septic periostitis, the one disease affecting the medullary tissue, the other the covering of the bone. In fact, one form of this disease, the idiopathic osteo-myelitis, or that occurring without a wound, is described by German authors as the same disease as that which we have considered above as acute diffuse periostitis, and will not further be referred to. We shall, therefore, confine our attention to those cases of diffuse septic osteo-myelitis where there is an open wound in the bone, as in a compound fracture, and especially gunshot fracture, or after amputation; bearing in mind, however, that there is an exactly identical condition, which may be set up where there is no visible opening by means of which micro-organisms could be introduced.

The traumatic form of diffuse osteo-myelitis is of septic origin, and is due to the decomposition of discharges in contact with the exposed medullary tissue. The disease is therefore of much less common occurrence than formerly, since more attention has been paid to the cleanliness and efficient drainage of wounds. It is an affection well known by its post-mortem appearances, which show in the first stage of the disease the whole medullary membrane, including in some cases that lining the cancelli, injected, thickened, sprinkled here and there with ecchymoses, and very soon permeated with purulent extravasation. The disease generally proves fatal at this point from pyæmia; for the veins, lying in rigid canals, cannot readily collapse, and thrombi form in them. These thrombi, being impregnated with septic material from the unhealthy processes going on in the wound, disintegrate, and are washed away in the circulation, and, forming emboli in the small vessels of other parts of the body, cause secondary abscesses wherever they lodge (Figs. 192 and 193). If the case does not prove fatal, the matter must make its way to the exterior through some sinus; the interior of the bone will die and form a slough or sequestrum, the compact tissue being



FIG. 191. Upper portion of humerus exarticulated for necrosis after osteo-myelitis. Amputation of the arm had previously been performed. The necrosis does not extend into the tuberosities, neck, or head of the bone, which, however, are expanded by inflammation (sometimes called osteoporosis).—After Longmore, in 'Med.-Chir. Trans.' vol. xlviii.

thickened and periosteal deposit formed on the surface, or the whole thickness of the bone may die (Fig. 194).

The symptoms during life are not equally familiar; nor is the disease often distinctly diagnosed, except in the case of amputation, when the cut end of the medullary cavity is exposed to view. In such cases, if the medullary tissue becomes inflamed, there will be seen sprouting from the cut end of the bone a large fungous granulation, in which specks of bone can be recognised; but in other instances, where the medullary cavity cannot be examined, we must endeavour to recognise the disease by its general symptoms. In such cases the symptoms will much resemble those of pyæmia, viz. rigors and acute traumatic fever, but with the addition of



FIG. 192. Osteo-myelitis of the femur.—From a drawing in the Museum of St. George's Hospital.



FIG. 193 Inflammation of the femoral vein from the same case.

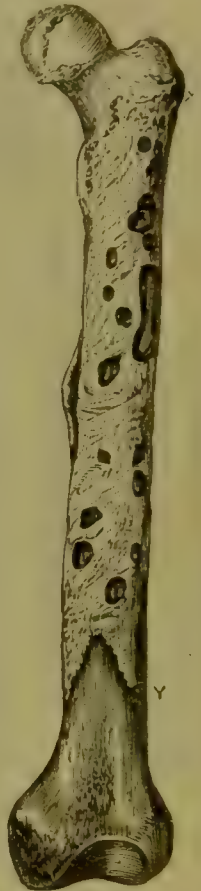


FIG. 194. A femur showing the whole shaft in a state of necrosis after osteo-myelitis from injury. X Y show the limits of the necrosis. The sequestra (which do not extend into the epiphyses) are visible through the cloaca. —After Longmore, *ibid.*

more or less pain in the part and swelling of the whole limb, not due to superficial œdema. If the limb be examined by a free incision down to the bone under anæsthesia, which, under such circumstances, is usually justifiable, it will be found that the periosteum has receded or is receding from the bone; and if the medullary tissue can be exposed it will be found to be suppurating. In the acute cases of this formidable disease there can be no question of the advisability—in fact, the absolute necessity—of instant amputation of the limb above the inflamed bone, if the patient is to have any chance of life; for the disease has a great affinity with pyæmia, which rapidly follows in the great majority of cases if they survive long enough for the symptoms to develop themselves completely. Unfortunately it is extremely

difficult to distinguish the symptoms at the outset, and in many cases, which are taken for mere osteo-myelitis, pyæmia has really commenced. In those cases where amputation is impossible, it has been suggested to lay the medullary cavity freely open with chisel or trephine, scrape out the medullary tissue with a sharp spoon, and apply iodoform. The treatment certainly merits a trial, and if performed early might probably be followed by a good result.

A very analogous condition to septic osteo-myelitis and to septic periostitis occasionally attacks the epiphysial cartilage of quite young children and is termed acute epiphysitis. It is probably in most cases an infective inflammation, the cause of which is not always evident, though it is frequently attributed to injury. It appears to commence in the layer of ossifying cartilage, and rapidly runs on to suppuration with disintegration of the cartilage and separation of the epiphysis from the shaft of the bone.

Acute
epiphysitis.

It occurs in infants or young children, usually under twelve months in age, and generally in those who are feeble and sickly, either from some inherited condition or from improper feeding. The parts most frequently affected are the two epiphyses of the femur and of the humerus. The disease is ushered in with profound constitutional disturbance, the child is manifestly very ill, with a high temperature, hot skin, constant moaning and crying out, and restlessness. There is frequent vomiting and diarrhœa. The affected part becomes swollen, red, hot, and tender, and soon grating on moving the epiphysis on the shaft of the bone can be felt, with increased mobility of the one part on the other. There is usually extreme depression of the vital powers, and the child frequently succumbs in two or three days. The treatment is the same as for the other forms of infective inflammation of bone: free and early incisions, washing out the part with some antiseptic solution, and careful drainage. At the same time the child's strength is to be maintained by every possible means.

One of the most curious local results of osteitis is the formation of a chronic abscess in the cancellous tissue. This occurs most often in the cancellous tissue of the head of the tibia—not unfrequently in that of its lower end (Fig. 195)—or in the lower end of the femur. It has, however, also been noticed in many other parts of the skeleton, and occasionally occupies a circumscribed part of the medullary cavity.

Chronic
abscess.

The symptoms are obscure, and the diagnosis is formed more by their persistence and by their resisting the treatment which usually relieves rheumatic pain in the bone than by any striking pathognomonic sign. There is constant wearing pain referred to the part, with little or no external inflammation, perhaps a little enlargement, and usually some local tenderness. When the abscess lies very near the cavity of a joint the inflammation may be propagated to the joint, giving rise to occasional attacks of synovitis, and in such cases there is considerable risk that the abscess may burst into the joint, and so lead, in all probability, to the loss of the limb or joint (Fig. 196).

The abscess is almost always seated in the cancellous tissue, and the bone around is usually somewhat thickened by inflammation (as in Fig. 197), and it seems to be due, in most cases at any rate, to contusion of the surface. In a striking case which occurred to me some years ago, the disease dated from a contusion by spent shot received at the battle of the Alma, more than fifteen years previously. In some of these cases the abscess contains a nodule of dead bone, and it seems very probable that in such cases a portion of the

interior of the bone has been so far detached from the neighbouring parts as to have perished. There are, however, many cases in which there has been no injury whatever. It very frequently occurs in scrofulous subjects, and is probably then due to the deposit of tubercle in the cancellous structure. In some cases it has been attributed to inflammation of a rheumatic nature, the result of cold.¹ The pus may remain encysted in the cavity for a very long period, possibly for the whole of life, since one of the earliest effects of the inflammation is to produce hardening ('sclerosis') of the bony walls of the cavity. But in other cases it does slowly make its way either to the cutaneous or the articular surface (Fig. 196), and I have known a case in which on turning down the periosteum a small opening was perceived leading into the abscess.

It is of great importance to diagnose this affection with at any rate such an approach toward certainty as will justify the surgeon in applying the trephine. When once the abscess has been opened the pain will cease, the cavity slowly fill up, and the patient be restored to perfect health. Mr. Carr Jackson (*op. cit.*) justly relies principally on the severity, the con-



FIG. 195. Chronic abscess in the lower end of the tibia. From a patient under the care of Sir B. Brodie (see his Works, vol. iii. p. 404).—St. George's Hospital Museum, Ser. ii. No. 30.



FIG. 196. Drawing of the lower end of the femur from a case of excision of the knee. An abscess which has formed above the position of the epiphysal line has made its way into the joint. The cartilages are seen ulcerated. A probe passed through the track of the abscess shows its opening into the articular cavity.—From a drawing in the Museum of St. George's Hospital, Ser. xxi. No 55b.

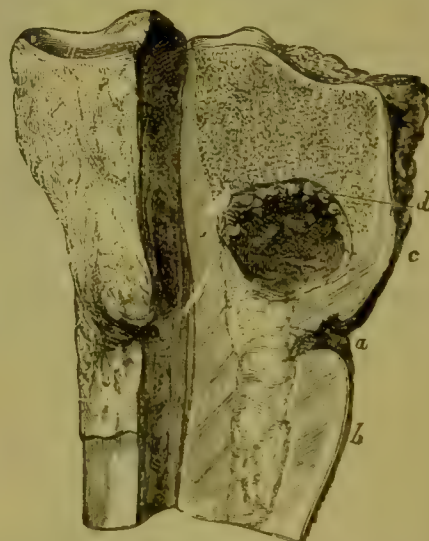


FIG. 197. Unsuccessful trephining in abscess of bone. *a.* The point where the trephine was applied, about half an inch from the abscess, *b.* The wall of the bone, thickened by inflammation. *c.* The cavity of the abscess. *d.* The pyogenic membrane. St. George's Hospital Museum, Ser. ii. No. 31.—From 'Syst. of Surg.' 3rd ed. vol. ii. p. 288.

¹ See the third case in Mr. Carr Jackson's pamphlet 'On Circumscribed Abscess of Bone,' London, 1867.

tinuance, and the paroxysmal character of the pain, and on the localised tenderness, sometimes referred to a single definite spot, pressure on which gives rise to the most agonising sensation. It must be admitted, however, that the diagnosis is not easy. Sir B. Brodie relates a case in which he applied the trephine and found no pus; Mr. C. Jackson recorded a similar instance, and one lately occurred in my own practice. In all these cases it is true that the operation did good; and it may be conjectured either, as Mr. Jackson seems to think, that there was a minute quantity of pus, which was not seen at the operation, but the evacuation of which relieved the pain, or that the relief was due to the incision of the tense and indurated periosteum and shell of the bone. In such cases, however, there has been, at any rate, osteitis, and the treatment by incision is a rational one whether necessary or not. But there can be no doubt that, in many instances, the mistake has been made of taking what is merely a neuralgic or hysterical affection for abscess of bone. Therefore the greatest care should be taken by the surgeon to assure himself of the reality of organic lesion, or at least to have the strongest evidence of it before undertaking an operation which is certainly serious, though not often fatal. The operation is a simple one. The surgeon, as Mr. Jackson recommends, would do well to mark out on the skin previously the precise spot to which the pain or tenderness is referred. The patient being fully narcotised, a crucial incision should be made down to the bone, the periosteum turned down by a similar crucial incision, and the trephine applied to the spot marked. If no pus be found it is well to perforate the walls of the trephine hole in various directions with a brad-awl or small chisel, in order to see whether the matter may be situated in the immediate neighbourhood. This was the case in the patient from whom Fig. 197 was taken. The trephine has been applied close to the collection of matter, but the latter was not opened, and the patient remained unrelieved till his death.¹

The figure illustrates almost every point in the surgery of the disease—the small cavity in the head of the bone, lined (as these abscesses almost always are) by a very definite pyogenic membrane, the slight tumefaction of the bone caused by the thickening of its periosteum, the induration of the bone around, and the tendency which the matter has to make its way, however slowly, to the surface, for all the bone which covered the matter has been removed at one point, and the wall is formed by the thickened periosteum only.

Caries is a more advanced stage of that condition, which, as we have seen above, exists in all inflammation of bone, viz. rarefaction. As we have already shown, when a bone becomes inflamed, there is first a stage of vascular engorgement and exudation of leucocytes, and then the original structure of the bone disappears, and is replaced by a new inflammatory tissue. Caries is merely a more advanced state of this same rarefactive process, when the changes have gone on to such an extent that the whole of the tissues of the

Caries.

¹ Or possibly till the limb was amputated. In the hospital catalogue it is said that 'the patient died some short time afterwards, and the abscess was then discovered.' Yet Sir B. Brodie alludes as follows to an exactly similar case, and Mr. Carr Jackson says that this preparation is taken from that case: 'A very experienced hospital surgeon applied the trephine for a supposed abscess in the head of the tibia. No abscess, however, was discovered, and in consequence the limb was amputated. On the parts being examined afterwards the abscess was discovered at a small distance from the perforation made in the operation, and it was plain that the removal of a small portion more of the bone would have preserved the patient's limb.'

bone have disappeared and are replaced by granulation tissue. Some pathologists, however, would limit the word caries to those cases of rarefying osteitis where suppuration has taken place, as the result of the conversion of the granulation tissue into pus; and indeed the word caries is employed with considerable looseness, and it would be better if it were done away with altogether, and the inflammation of bone which leads to caries described, as it sometimes is, as 'rarefying osteitis,' and then each variety as regards its causation and results could be described separately.

Caries or rarefying osteitis commences, then, as an inflammation of bone. The blood-vessels dilate and there is an exudation of leucocytes and liquor sanguinis. This exudation collects in the Haversian canals, forming masses of granulation tissue which eat into and destroy the walls of the canals, forming crypts or recesses (Howship's lacunæ) which are filled with granulation tissue. So far the process has been one of simple osteitis, and here it may stop, the granulation tissue becoming absorbed, or undergoing a process of ossification and becoming converted into new bone. But in caries the rarefying process goes on, the granulation tissue increases more and more in quantity, and gradually eats away and replaces the natural tissues. The disease is most common in the spongy bones, the cancelli of which become thinned and absorbed and finally disappear, so that at last we may have nothing else but a thin shell of compact bone, containing little but granulation tissue. Changes, however, occur in this embryonic tissue which generally proceed side by side with the process above described, so that we rarely find the *whole* of the cancellous tissue of a bone destroyed and replaced by granulation tissue, but while this process is going on in one part of a bone, in another the further changes in this tissue which we have now to describe are taking place.

In the first place, the most common change which this material undergoes is one of degeneration, and it becomes converted into pus; and thus we have an abscess formed. Generally, however, this retrograde metamorphosis takes place before the whole of the bony tissue has been absorbed, and we have the remains of the softened and expanded bone infiltrated with purulent matter.

In some instances the granulation tissue is formed with great rapidity—more rapidly than it is converted into pus. We then find it destroying the bone and sprouting on the surface of the skin or into joints, and this form has received the name of *caries fungosa*. Again, in other cases the granulation tissue becomes converted into pus before it has had time to destroy and replace the bone. Under these circumstances, the bone, being deprived of all nutrition from being infiltrated with pus, dies *en masse*, and we find portions of dead bone, worm-eaten and partially disintegrated, lying in the suppurating cavity which has been formed by the conversion of the granulation tissue into pus. To this condition the term *necrotic caries* is applied.

Secondly, the granulation tissue may not become converted into pus. It may undergo a process of fatty degeneration and caseation without suppuration, and finally may wither away and absorb or become calcified. This is termed *caries sicca*, and is often seen in Pott's disease of the spine, where there may be extensive caries and destruction of the cancellous tissue of the bodies of the vertebræ without any formation of matter.

Or, finally, the granulation tissue, as in soft parts, after having destroyed and replaced the bone, may undergo a process of organisation, and become converted into fibrous tissue or scar tissue and eventually ossify.

There can be no question that caries occurs most frequently in strumous subjects, and in many cases is due to some slight exciting cause, as an injury which in a healthy subject would be followed by no evil results. In the strumous subject, however, it sets up a chronic inflammation, which persists and constitutes a favourable nidus for the development of tubercle, which caseates early, and subsequently softens, exciting inflammation in the parts around. It is therefore both the cause and the consequence of scrofulous caries. Attention has been drawn to the fact that caries most commonly occurs in cancellous bones, such as the bones of the tarsus and spine and the epiphysial extremities of the ends of long bones, where red marrow is found. Now this red marrow has long been known to physiologists to be identical in structure and function with the adenoid tissue of lymphatic glands, and the two diseases of scrofulous glandular inflammation and scrofulous caries would appear to be identical. In both there is some irritation which excites an hyperæmia of the tissue; in both this is attended by a deterioration of the structure of the part which forms a suitable nidus or soil for the development of tubercle; in both, at all events in very many instances, tubercle bacilli and giant cells are found; and this renders it probable that an ordinary strumous gland and caries of bone, as it usually occurs, are identical diseases. As in strumous glands, so in caries, in the majority of cases, cheesy deposit is to be found in the inflamed bone (as in Figs. 203, 204, p. 450); and some authors would consider this as the product of tubercle, whether this was the starting-point of the disease or whether it occurred as a secondary complication. Caries may, however, also be the result of syphilis when it principally affects the compact bones, especially those of the cranium, the nasal bones, the palate, and the tibia. It is then usually the result of a subperiosteal gumma, but may be due to a gummatous tumour in the substance of the bone. The bone substance is absorbed and replaced by granulation tissue exactly in the same way as in strumous caries, with or without suppuration. Usually there are a number of these deposits, so that the bones present a peculiar worm-eaten appearance; and frequently it presents the particular form which has been described as necrotic caries, when portions of bone die *en masse*, probably from the inflammation being more intense and producing acute strangulation of the vessels and death of the bone before the inflammatory exudation has had time to absorb the implicated portion. Caries independent of any constitutional cause and depending solely on a local cause is not common.

The symptoms of caries are, in their earliest stage, very equivocal, and are, in fact, those of chronic osteitis. There is pain, especially on jarring or striking the bone, with slight enlargement. This is followed by redness and a certain amount of swelling and œdema of the soft parts, and eventually by a sensation of fluctuation, the changes being exceedingly slow and chronic in their progress. But there are also the symptoms of chronic osteitis. After the abscess has burst or has been opened there is often no difficulty. There is a sinus leading down to exposed, softened, rough bone, which bleeds readily under the touch of the probe. The discharge has sometimes the foetid, offensive smell of putrefying bone, but by no means always. But in many cases of deep-seated caries, the diagnosis is often only inferential, i.e. no other cause can be assigned for the persistence of discharge, with perhaps some pain or symptoms of inflammation around the bone. Often also the prominence of the granulations around the opening of a sinus gives indication of the presence of an abiding source of irritation below, which, if not a foreign

body, can hardly be anything except a piece of dead or diseased bone. If a carious bone is removed from the body it is found to be in various degrees of softening. Sometimes it consists of merely the outside shell of compact tissue, which may be expanded, filled with pinkish granulation tissue or broken-down suppurating material—a condition to which the older authors applied the term *spina ventosa*; or the remains of the cancellous bony tissue may be present, softened and infiltrated with inflammatory products, so that it can be cut with a knife. These inflammatory products consist of semi-gelatinous or purulent material, mixed in greater or less proportions with cheesy matter. After maceration, the bone presents a beautiful, porous, worm-eaten appearance, exceedingly light and fragile, and weighing very much less than the healthy bone (Fig. 198).

The treatment of caries must often be expectant merely, as in the instance of carious spine, as far as any application to the diseased surface is possible, though much may be done in treating the constitutional cause which gave rise to the disease. And many good surgeons are inclined to believe that the expectant treatment is the best in almost all cases, whatever the situation of the disease. When, however, the disease has existed for some time, and there seems to be no prospect of any reparative action going on, there is but one treatment, viz. removal. The methods of operation are various. The most common one is to expose the diseased bone and to remove as much as is found to be diseased with the chisel, gouge, or some cutting instrument until a surface of bone is reached sufficiently healthy to take on reparative action; and this plan is sometimes successful. It is best performed with the limb rendered bloodless by Esmarch's Bandage.

But in many cases it is liable to the danger of extending the disease instead of stopping it, by the inevitable contusion and crushing of the portion of bone left behind. So that in many cases, where a single short bone, as one of the bones of the tarsus, is affected, a better and a more certain result is obtained by resecting the whole bone, if the disease is confined to a single one. This operation is usually followed by the most satisfactory results, even after two or three gouging operations have been performed without benefit, and singularly little deformity is left. Even after the removal of one of the more important bones of the tarsus, such as the astragalus or os calcis, the patient recovers with a thoroughly useful foot, and has scarcely even a perceptible limp in walking. When more than one bone is involved the case is rendered more serious; but two, or even three, of the bones of the tarsus may be removed and still the patient have a very useful member. When the disease affects the articular ends of the long bones this treatment cannot be adopted, and the question of excision or amputation then arises, which will be considered in the sequel.



FIG. 198. The head and upper part of the shaft of the humerus, extensively ulcerated. The head is in great part destroyed. A transverse fracture of the shaft of the bone has taken place immediately below the head. Below the part where the shaft of the bone has been broken a considerable amount of new bone is thrown out in the neighbourhood of the fragments, which are only slightly displaced. The medullary canal is open throughout. —St. George's Hospital Museum, Ser. ii. No. 46.

Other local means of treating this condition have been advocated. Mr. Pollock recommends that the diseased bone should be dissolved by a strong solution of sulphuric acid.¹ And Dr. Kirkpatrick effects the same object by the caustic action of Vienna paste (potassa cum calce).² Other local applications are the actual cautery, the injection of iodine, and injections of dilute mineral acid; which, however, are now superseded by the use of the stronger acid. Solutions of iodoform are now employed, and, it is said, with some success. Hueter, in cases believed to be tubercular, before abscesses have formed, recommends injections of dilute carbolic acid into the bones themselves, by means of a perforated trocar driven into their substance.

Necrosis, or the total death of a considerable portion of bone, is distinguished from caries, or the ulceration of the bone and its disintegration in invisible molecules, just as gangrene, or death of a visible portion of the soft tissues, is distinguished from ulceration, or 'molecular gangrene.' The phenomena of necrosis, also, are strictly analogous to those of gangrene. It may be produced, as gangrene is, either by inflammation, or by loss of blood-supply, or by chemical disintegration of the tissues; but in the bones inflammation is a far more common precursor of necrosis than it is in soft parts; in fact, the cases where necrosis does not depend on inflammation are only exceptional, while in the soft parts, though inflammation usually bears its part in inducing gangrene, yet other causes almost always co-operate. The reason of this is obvious: the soft parts easily accommodate themselves to the enlargement of the vessels and to the intervascular effusions which are necessary accompaniments of inflammation; whilst in the bones the vessels are confined in rigid canals; and any such attempt at expansion being checked at once, the circulation comes to a standstill. The dead bone then turns white (unless it is exposed to the air and bathed in the products of putrefaction, when it may be perfectly black); if cut into it will not bleed; the periosteum and soft parts recede from it, leaving its surface smooth, hard, and ringing when struck; the living bone in the neighbourhood becomes inflamed, leading to condensation of its tissues for some distance, and to periosteal deposit, both on the surface of the living bone and especially over the dead bone, so that the dead bone is roofed in or *invaginated* (as the technical term is) by a cover or sheath of living periosteal bone. While this is going on, the irritation of the dead bone sets up inflammation in all the parts with which it is in contact, viz. the living bone and the deep surface of the periosteum. The pus so furnished finds its way to the surface through the sheath of new bone, which thus is interrupted by holes or sinuses, through which the pus burrows to the surface of the body. These sinuses are technically called *cloacæ*, and the piece of invaginated dead bone thus sequestered from the soft parts is called a *sequestrum*. When the periosteum is destroyed there is usually no sheath, though it is possible that new bone may be produced by the soft parts. This, however, is a far slower and more imperfect process. When there is no sheath and the dead bone is exposed on the surface the process of separation and the piece of dead bone which separates are both described by the name of *exfoliation*. As the inflammation proceeds it digs a trench around the dead bone by a line of demarcation, as in the soft parts, and thus the sequestrum becomes loose in its cavity, and if the *cloacæ* are large enough it may escape through one of them. But this rarely

¹ 'Lancet,' May 28, 1870.

² 'Dub. Quart. Journ.' 'New Syd. Soc. Bien. Rep.' 1867-68, p. 259.

happens, and for the most part it is necessary to enlarge the opening of the cloaca before the sequestrum can be removed.

This description applies to necrosis of the superficial part of the bone, and this is by far the most common situation. Central necrosis, however, is occasionally, though not very frequently, met with, as the result of inflammation of the medullary tissue, possibly caused by contusion of the substance of the bone. The symptoms are very obscure, and are, in fact, usually merged in those of chronic abscess; since the resulting inflammation, supposing the affection to be seated in a part such as the head of the tibia (where there is abundance of cancellous tissue), will set up suppuration around the dead bone. In the shafts of the long bones the same thing may occur. The pus will become diffused among the meshes of the medullary tissue, and the disease has been known to be many years in progress before the dead bone has become loose.¹

Suppuration may be long delayed in cases in which the necrosis is the result of chronic osteitis—‘for months, and possibly even years’—and in such cases there is considerable resemblance to malignant disease, especially as spontaneous fracture may occur. In these cases the necrosis attacks the substance rather than the surface of a bone, and the new bone which will ultimately invaginate the sequestrum is furnished by the endosteum as well as the periosteum. The reader is referred to an interesting paper in vol. lx. of the ‘Med.-Chir. Trans.’ by Mr. Morant Baker, on ‘Necrosis without Suppuration.’

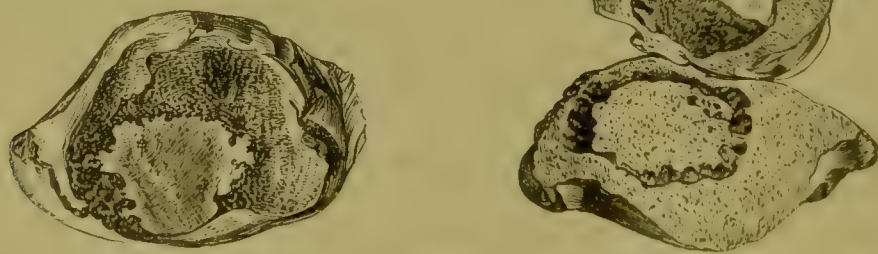


FIG. 199. Necrosis of the lower part of the shaft, and epiphysial extremity of the tibia. The larger figure shows the sequestrum surrounded by its sheath of new bone, the latter gradually merging above into the healthy surface of the bone. A section has been made through the sequestrum and its cavity near the articular surface. The smaller figure shows the articular end of the bone, where the extremity of the sequestrum is seen, surrounded by an ulcerated surface of bone, from which the articular cartilage was completely removed. The sequestrum was here perfectly accessible, and could have been removed by a free incision into the joint.—From a drawing in the Museum of St. George's Hospital, presented by Sir B. Brodie.

The bones most subject to necrosis are those which are most exposed to the various causes of inflammation, of which syphilis, struma, and local

¹ In the Museum of St. Bartholomew's Hospital, Ser. i. No. 176, is a specimen of a femur removed by amputation, in which there was a small necrosed portion of the inner layers of the medullary cavity. The bone had not separated, though the disease had been in progress for thirty-five years.

violence are the commonest. Hence the superficial bones are found affected more commonly than those which are further removed from participation in the various affections of the surface. The cranium, the tibia, the clavicle, the bones of the forearm and hand, are most commonly the subjects of the affection; but it is by no means uncommon in the femur or humerus. The denudation of the bone by destruction of its periosteum is very frequently followed by necrosis, but not always, since the exposed bone may derive sufficient nutriment from the neighbouring parts of the bone, and to some extent from the neighbouring soft parts, to preserve its vitality. Thus

after a severe scalp-wound large portions of exposed bone may be seen to become gradually vascular, small granulations springing from the surface here and there, and ultimately forming a cicatrix by which the whole is covered, without any visible exfoliation. And in the bones of the face large denudations of the periosteum are perfectly compatible with the regular nutrition of the bone. Thus, in the operation for cleft of the hard palate, the surgeon denudes the bones of their periosteum, without any apprehension whatever of necrosis. But in bones which are less vascular than those of the head and face, or in bad conditions of health, or where the denudation is very extensive, the outer table of the bone will usually exfoliate, though not to so great an extent as would at first appear probable. The soft parts almost always adhere around the edges of the wound to some extent, and preserve the life of the circumferential portions.

Necrosis sometimes occurs with almost as much rapidity as gangrene of the soft parts, and then the constitutional disturbance may be great, and pyæmia is very likely to ensue. I have spoken of this in connection with diffuse or acute periostitis, which is the common cause of acute necrosis. The next most common cause is destruction of the periosteum and injury to the surface of the bone, either by contusions, chemical injuries, or fire. But there are rare cases in which acute necrosis ensues from obscure

Acute
necrosis.

FIG. 200. Extensive ulceration of the tibia and fibula, with necrosis. Both bones are much thickened by inflammation, and covered with a deposit of new porous bone. The large irregular cavity which is seen in the tibia has resulted from the necrosis and removal of the whole thickness of the shaft of the bone, with the exception of two small bridges or pillars, which extend from the upper to the lower end of the tibia. The tibia is firmly soldered to the fibula, above, below, and opposite to the cavity.—From a preparation in St. George's Hospital Museum, Ser. ii. No. 51.

causes, and without any visible affection of the periosteum or medullary membrane, of which I have related a striking instance in the essay already referred to in the 'System of Surgery' (p. 302). Such cases must be treated in the same way as those of acute periostitis.

The treatment of necrosis is, as a general rule, to wait until the bone is loose and then to remove it. In the case of an exfoliation nothing more is necessary than to lift out the loose portion by putting an elevator beneath its edge, and extract it with a pair of forceps. Very often when the soft

Treatment
of necrosis.

parts lock-in the exfoliation it becomes necessary to cut the loose portion across in order to remove it piecemeal; and this is effected by a pair of cutting forceps or bone-scissors. But under certain circumstances this usually simple operation becomes a very complicated, difficult, and dangerous proceeding. The most familiar instance is in that necrosis of the popliteal space of the femur which occurs so often, and in which, for some not very obvious reason, there is rarely, if ever, any periosteal sheath, so that the exfoliated bone lies close under the popliteal artery, and may easily wound it, as happened to a young man the subject of this affection, who in dancing ran the loose splinter of bone into the popliteal artery and bled to death.¹ The same accident may occur in removing the bone, or the knee-joint may be opened, or the artery may be wounded by the knife, trephine, or cutting pliers. It is necessary, therefore, to proceed with great care, making the incision on the outer side and somewhat to the back, so as to avoid the synovial membrane, yet not to wound the external popliteal nerve; then to dissect with great care along the back of the femur, and use the bone-scissors, if necessary, with great caution. In withdrawing the bone all rough manipulation should be avoided, and the parts scratched and pushed off it with the finger-nail and handle of the scalpel in preference to any cutting instrument. Esmarch's Bandage is of great use in operations of this kind.

When the dead bone is invaginated it is necessary, in the first place, to endeavour to ascertain whether it is loose; but this is by no means easy. The length of time during which it has been exposed will of course justify a guess—but only a guess—for the period at which the dead bone separates depends on many causes, of which the surgeon can hardly have any knowledge, and in great part on the acute or chronic nature of the original action. Still, if the disease has been long in progress, and there is not much risk in cutting down on the bone, it should certainly be done, if only to get a perfect knowledge of its condition. The sequestrum may be quite detached from the bone around it, yet so locked in that no movement can be impressed on it by the probe. Sometimes the groove of demarcation between the living and dead bone can be felt, and if so it is a valuable sign that the sequestrum is loose. The operation consists in freely exposing the invaginating bone with its cloacæ, and enlarging one or more of the latter by cutting the new bone away, either with the trephine applied round one of the openings, or by cutting through the bridge between two neighbouring cloacæ with chisel or forceps, and so obtaining free access to the sequestrum, which is then to be taken out with the forceps, or, if too large, to be cut through with the cutting pliers, trephine, or any handy instrument, and so removed. The surgeon must be careful to leave none of the dead bone behind in the cavity. The wound need not be closed, since it can only fill up by granulations. The discharge is often most putrid, and the pit in the bone requires for some time to be very freely washed out with some disinfecting solution.

It used to be recommended in surgical lectures to defer this operation till the periosteal sheath might be presumed to have acquired strength enough to preserve the continuity of the limb; but this is not now considered advisable. In the leg and forearm, where there is a second bone, the periosteal inflammation will be sure to unite the affected to the sound bone, if the necrosed portion be at all large (see Fig. 200): and even if this does not occur, or if there is only one bone, it seems better to remove the sequestrum at once,

¹ Byron, in 'Med.-Chir. Rev.' vol. xxiv. p. 259. Jacob, 'Diss. Med.-Chir. de Aneur.' Edin. 1814.

since it is a permanent source of irritation, and to trust to careful splinting and bandaging to maintain the parts in position and prevent any fracture. However, it cannot be denied that the danger of fracture from necrosis is a real one, and particularly if the neighbouring bone has been cut away to some extent; and when this accident has happened in the case of the femur,

Fracture
from
necrosis.



FIG. 201. Fracture in consequence of necrosis, necessitating amputation, from which the patient (a boy, aged 15) recovered. *a* refers to the necrosed bone; *b* to the new bone, which (along with the remains of the old shaft) has given way. The patient had had diseased bone for more than four years, and had been frequently operated upon. At length he again came into the hospital in 1861. The femur was trephined, and some more dead bone removed. He went on well and the wound was nearly closed, when six weeks after the operation, he fell in running across the ward and fractured the thigh. It was put up in the usual way, but no union could be procured. The wound discharged a large quantity of thin, unhealthy pus, and it became necessary to amputate. The fracture has passed through the trephine-hole, a part of the outline of which is seen on the necrosed bone. The artery lay to the inner side of the broken ends—it was uninjured. The interspace between the fragments was filled with white fibrous tissue, in which many ossifying specks were visible under the microscope.—St. George's Hospital Museum, Ser. ii. No. 100.



FIG. 202. Necrosis of the whole shaft of the tibia, from a patient aged 18. The upper epiphysis is unaffected, but the disease extends into the ankle joint, and a small loose portion of bone can be seen in the lower articular surface. The patient was originally admitted in the year 1838, the disease having then existed for four years, and being referred to an accident. Some dead bone was then removed, and he was sent into the country, as his health was failing. Next year he was readmitted, and the greater part of the necrosed bone was extracted, through the large aperture (made by the trephine and other instruments) seen at the upper part of the shaft of the bone. Numerous other openings are seen, most of which are cloacæ, one of them of a rounded form, probably the former trephine hole. The lad died shortly after the last operation from another cause.—St. George's Hospital Museum, Ser. ii. No 80.

amputation will usually become necessary (Fig. 201). In the arm careful treatment will probably preserve the limb.

Some other plans of dealing with necrosed bone are occasionally useful. They consist chiefly in applying chemical solvents, by which the dead bone may be dissolved out, and thus its removal be effected more quickly than by

waiting for its separation. Of these the sulphuric acid is the best (see page 445), and by its means I have seen large portions of the skull removed, and certainly with the effect of much diminishing the fœtor of the discharge. The difficulty is when the limits between the dead and the living bone are reached, since any substance strong enough to dissolve the tissue of the bone may easily kill the living, but inflamed bone, in the neighbourhood of the exfoliating portion.

Complica-
tions.

The complications of necrosis are very numerous; but as the majority of them are merely the results of inflammation propagated from the inflamed bone to the soft parts in its neighbourhood, and are marked by the symptoms peculiar to such inflammation, it would be impossible to speak of all of them here, nor would it be necessary. It may perhaps, however, be proper to take notice of the fact that necrosis is not an uncommon cause of destructive inflammation of joints. Usually, indeed, the inflammation of the shaft of a long bone is not communicated to the articular end; but this is not always the case. The articular end itself may share in the death of the shaft, or the supuration which is excited by the sequestrum may perforate the articular lamella and make its way into the joint, as in Fig. 202; or, again, the necrosis may be confined to the articular end, the shaft being free, so that the whole or a portion of the epiphysis may become loose in the joint and act as a foreign body. The joint under any of these conditions must be considered,

as a general rule, to be destroyed, and it becomes merely a question whether amputation is necessary, or excision may be ventured on, or the loose bone only be extracted by incision into the cavity of the joint, and the latter left to ankylose.

Scrofula
in bone.

I must now give a very brief account of the modifications of the inflammatory process caused by the various constitutional cachexiæ. And first as regards scrofula of bone.

From what has been said on a preceding page (page 382), it will be gathered that there is good cause to consider scrofula and tuberculosis as pathologically identical; and therefore scrofula of bone resolves itself into a con-



Fig. 203. Scrofulous tubercle deposited in the head of the right femur. 'The cartilages had been destroyed by ulceration, and the bones were in a state of caries.' The section of the bone shows a large mass of yellow substance deposited in the cancellous tissue.

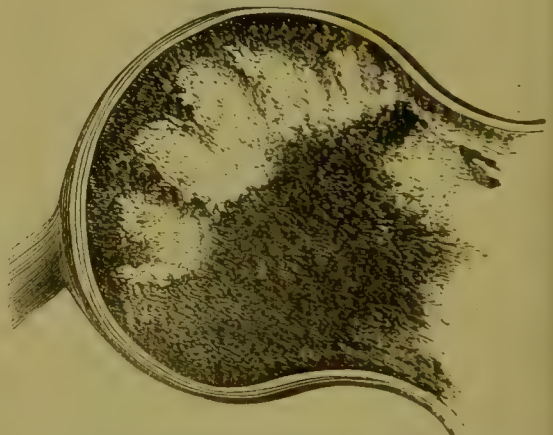


Fig. 204. Deposit of tubercle in the head of the left femur from the same case as the preceding. No disease had been supposed to exist in this joint before death, and the drawing shows the cartilage and ligamentum teres intact, but the bone was softer than natural, and its vascularity increased.—From drawings presented by Sir B. Brodie to the Museum of St. George's Hospital. The case (that of Captain D. case xxxi.) is to be found in his 'Treatise on Diseases of the Joints,' Works, edited by C. Hawkins, vol. ii. p. 196.

sideration of tubercle of bone. Tubercle, as it occurs in bone, is exactly the same in structure as when it occurs elsewhere, and passes through the same changes. It begins as a small, hard nodule (grey granulation), consisting of giant cells, epithelioid and round cells, occurring in the red marrow of cancellous bone. Then these isolated particles become fused together and form a confluent mass, which early undergoes fatty degeneration and caseation, and presents a mass of crude, cheesy tubercle in the cancellous tissue (Figs. 203, 204). Inflammation, in the form of rarefying osteitis, is set up in the tissues around, constituting the strumous caries above referred to, and the tubercular matter soon disappears in the breaking down of the granulation tissue of the osteitis and its conversion into pus. This pus, from its admixture with the caseous *débris*, acquires its well-known character of 'curdy pus.' The true nature of the case can, however, almost always be demonstrated by the existence of outlying grey granulations at the periphery of the inflammatory zone.

The symptoms of the disease are simply those of caries, as detailed above. As a part of a general tuberculosis, it runs a rapid course, and is a fatal disease. As caused by local infection from some caseating material, it produces all the symptoms of scrofulous caries, and ends in the destruction of the bone by suppuration, and may be the source of general tuberculosis in the system.

Syphilis as it attacks the bones in adult life leads either to periostitis, or to osteitis, caries, and necrosis. As a periostitis, it is most frequently met with as a gummatous deposit between the bone and periosteum, which forms a hard, rounded tumour, the periosteal node, which has already been described.

Syphilis in
bone in
adult life.

This gummatous deposit breaks down, forming an ulcer, which eats into and disintegrates the bone beneath, constituting *caries*. This is frequently accompanied by *necrosis*, where the bone perishes from want of sufficient blood-supply in consequence of the periosteum, from which the supply of blood is mainly derived in some bones, as those of the face and the outer table of the bones of the skull, being separated from the bone by the inflammatory effusion. In these cases the two diseases of caries and necrosis go hand in hand, and we often see a circular trench of ulceration marked around a worm-eaten portion of bone, which, as it widens and deepens, undermines and finally separates the piece, which constitutes a sequestrum. Occasionally gummatous deposits take place in the medullary structure of bone or in the diploë of the bones of the skull, first causing expansion of the compact tissue, then breaking down and suppurating, and eventually causing necrosis of the bone. Sometimes also, in the skull, gummata may form on the inner aspect, between the bone and dura mater, causing irritation of the brain, and giving rise to cerebral symptoms.

In addition to the deposit of gummatous material in or on bone and its production of caries and necrosis, another morbid condition is occasionally set up as a result of the syphilitic dyscrasia, viz. a chronic osteitis, and periostitis going on to sclerosis. It generally affects the long bones of the extremities, but may also occur in the bones of the skull. It consists in a chronic form of inflammation affecting the whole of the connective tissue of bone, so that the periosteum and the connective tissue in the interior of the bone all become involved, and as a result there is a new osseous deposit on the surface from the periosteum, and a similar growth in the interior which may completely fill up and obliterate the medullary cavity, while the bony tissue itself is much thickened and sclerosed.

I think it unnecessary to add anything here on the subject of the general treatment of syphilis in bone to what has been already said on the general subject of constitutional syphilis, and it remains necessary, therefore, only to say a word or two on the local treatment. As a rule nodes require no local treatment in their early stage, and no operative interference is to be adopted until there is undoubted evidence of the presence of matter. In the softened stage of a node, even when distinct fluctuation is present and it presents almost all the characters of an abscess, still absorption may take place under constitutional treatment. When there is no doubt about the presence of pus, the abscess must be opened; when the bone becomes carious it must be scraped away with a sharp spoon, and any necrosed portions removed as they become loose. After the abscess has been opened and the surface of the bone exposed, undoubtedly the best local application is iodoform, insuflated into the wound and covered with gauze saturated with the same material, or, if warmth and moisture are desired, with hot boracic lint.

Malignant
tumours of
bone.

All malignant tumours occurring primarily in bone belong to the class of sarcomatous growths. The carcinomata, though formerly believed to constitute a large group of malignant tumours of bone, are rarely or never found as a primary growth in this structure. When they do occur, then it is as a secondary growth to a carcinomatous tumour in some other part of the body, or as a local extension from some primary growth in a neighbouring structure. As a secondary tumour the carcinomatous growth is generally of the scirrhous variety; while carcinoma of the soft parts spreading down into the bone is usually epithelioma. In these latter cases the tibia is the usual seat of the affection, of which an example is shown in Fig. 205.

The sarcomata of bone are divided for purposes of description into two classes, according to the part of the bone from which they grow. Those growing from the surface of the bone—i.e. the periosteum—are termed *peripheral*; whilst those growing from the interior of the bone are classed as *central*. And these two varieties differ in their clinical and anatomical characters, at all events as regards the latter, in respect to the relative frequency with which one or another variety of sarcoma is present.

Central
Sarcoma.

The central sarcomata grow from the medullary tissue in the cancellous structure, generally at the extremities of the long bones, or from the medulla contained in the shafts of the same bones. As they grow they expand the bone, which becomes much thinned, until at last the portion of bone involved consists only of a thin shell of compact bone enclosing the

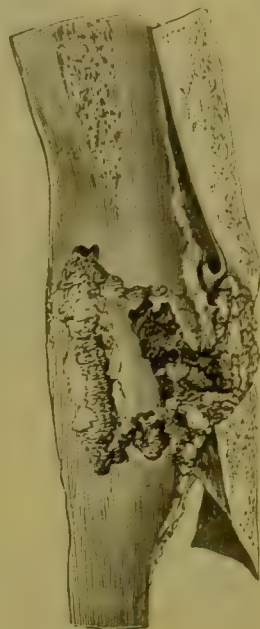


FIG. 205. A section of the skin and of the shaft of the tibia in a case of epithelial cancer for which the leg was amputated. The skin is seen to present a large ulcerated space, which is continued downwards into a cavity hollowed out in the shaft of the bone. The cavity is of large size, irregular in form, and lined by a thick layer of firm substance, which is continuous with the ulcer on the surface of the skin. The bone is much thickened around the diseased part and its medullary canal obliterated for some distance. The ulcer on the surface, the firm lining of the cavity in the shaft of the bone, and the soft matter infiltrated in the cancelli above that part, consist entirely of scaly epithelium packed together by a fine granular substance. The patient was a man aged 54, and the disease was referred to a blow received two years previously, six months after which a tumour formed in the part struck and rapidly sprouted out of the skin. This tumour had been removed three times by the knife, and a fourth time by caustic, along with a scale of bone, before the limb was amputated. He recovered from the amputation, but the subsequent progress of the case is not known.—St. George's Hospital Museum, Ser. ii. No. 338.

growth (Fig. 206). The bone at last becomes so thin that it yields under the pressure of the finger, and emits a peculiar crackling sensation, like parchment, to which the name 'egg-shell crackling' has been given. Finally the growth bursts through the thinned bone and diffuses itself in the soft parts. At first these tumours grow slowly, but, having burst through the bone, they commence growing with much greater rapidity, and speedily attain a large size. In consequence of the structure of the bone being destroyed by the growth, it becomes weakened, and frequently fracture may take place from some slight violence, or even from some movement on the part of the patient, such as turning in bed. And it not uncommonly happens that this is the first real indication to the patient that there is any active disease going on, no previous symptoms having drawn his attention to the part, beyond perhaps some obscure pain, which probably has been regarded as rheumatic.

When these tumours occur in the cancellous tissue at the ends of the long bones, they rarely penetrate into the joint. They may destroy all the bony structure, including the articular lamella, but the cartilage appears to have the power of resisting their invasion, and remains unperforated.

The central sarcomata may consist of any of the varieties of sarcoma: round, spindle, mixed, or myeloid-celled sarcoma; but that form containing the large, giant cells commonly known as myeloid-celled is the one most frequently found, and is at the same time the least malignant, showing the least tendency to re-



FIG. 206. Central sarcoma of lower end of femur. The whole of the bony tissue of the lower end of the femur has been destroyed and replaced by the sarcomatous tissue, but the articular cartilage remains intact. - From a preparation in St. George's Hospital Museum, Ser. ii. P. 67 c.

turn, and remaining tolerably circumscribed; whereas the other forms, as a rule, diffuse themselves along the marrow of the shaft of the bone. The central sarcomata show little tendency to ossify or undergo those other secondary developmental changes to which sarcomata are liable (p. 373), but they occasionally reproduce themselves in distant internal organs, though rarely in the lymphatic glands.

The peripheral sarcomata grow from the osteo-genetic or deeper layer of the periosteum, and, unlike the central growths, they are especially prone to undergo ossification or chondrification, and that so rapidly that the mass of the tumour appears to be made up of bone or cartilage, as the case may be, covered only by a thin layer or envelope of sarcomatous material. This has given rise to the terms osteo-sarcoma and osteo-chondroma, which, as Mr. Butlin has so emphatically pointed out, are exceedingly inappropriate

Peripheral
sarcoma.

and misleading appellations, and have caused some authors to classify these tumours in a separate group, when, in fact, they are purely sarcomatous in their behaviour and ought to be regarded as such. The peripheral sarcomata generally start from one side of the bone (Fig. 207); but as they grow they may embrace the whole bone (Fig. 208). In their growth they invade the bone from the outside, but do not expand it. The growth in the peripheral sarcomata, as in the central form of the disease, may consist of any of the varieties of sarcomata; but here the spindle-celled and round-celled are much the most common. The myeloid form, except in connection with the lower jaw, is rare.

A very large proportion of sarcomata of bone, whether central or peripheral, is traceable to some injury, such as a kick, blow, or fall; and in the majority of cases the patient himself will attribute his disease to this cause; as it followed shortly after the injury, before it was forgotten, and appears at all events to him to be the direct causal agent. They occur as a rule in early life, in the majority of cases before the age of thirty; though no age would appear to be exempt from this disease.

In the *central* form there is, in the early stage, a slow, uniform, spherical enlargement

of the bone, which is at first hard, and is accompanied by an aching, gnawing pain; and in this condition it is very liable to be mistaken for chronic osteitis



FIG. 207. Periosteal sarcoma of the tibia. The chief deposit exists between the periosteum and the bone, the surface of which has been slightly destroyed. Corresponding to the situation of the tumour, the cancellous tissue and medullary canal were, however, infiltrated to a very slight extent.—St. George's Hospital Museum, Ser. ii. No. 244.



FIG. 208. A section of a malignant tumour, springing from the periosteum of the humerus, and infiltrating the muscles and parts in the neighbourhood. The bone appears unaffected. The arm was removed at the shoulder-joint.—St. George's Hospital Museum, Ser. ii. No. 225.

and abscess of bone. There is, however, no redness and heat or other sign of inflammation, such as œdema of the soft parts over the bone; nor is there any rise of temperature or general pyrexia.

As the tumour grows it expands and thins the bone, and 'egg-shell crackling' becomes perceptible, especially if the growth undergoes degenerative changes and cysts become formed in it, as is very frequently the case. The skin over it becomes covered with large veins, and frequently a distinct pulsation is to be felt in it, and occasionally a bruit can be heard with the stethoscope. After it has perforated the bone and diffused itself into the soft parts it presents a rapidly growing tumour of unequal consistence, but for the most part soft and semi-fluctuating, and the seat of considerable pain.

The *peripheral* form generally consists, in the first stage, of an elongated swelling attached to the bone and diffusing itself along the shaft. It is situated at first on one side of the bone, and appears to be a direct outgrowth from it. These tumours vary much in consistence, not only in different tumours, but also in different parts of the same tumour. Some are uniformly hard; others uniformly soft, and almost apparently fluid in consistence; whilst most are hard and firm in some parts, soft and diffuent in others. Pulsation is not nearly so common in this form of growth as in the central one, though it is sometimes to be observed in the multiple sarcomatous tumours which are occasionally found affecting the skull.

The peripheral sarcomata grow more rapidly and are altogether more malignant than the central ones. They show a greater tendency to recur locally after removal and to invade internal organs. Occasionally in these cases the lymphatic glands are found to be implicated.

The diagnosis between malignant and innocent tumours of bone is based on the following considerations. That in the malignant growth the tumour is large, of varying consistence in different parts, growing rapidly, covered with large veins (which, indeed, are only an evidence of its rapid growth and the consequent profuse blood-supply with obstructed return), involves a considerable surface of the bone, and is attended with constant pain. If a tumour of bone be diagnosed as being malignant, its removal is plainly indicated. Amputation, if possible, is the only treatment; and the sooner it is done the better. The only question to consider is where the amputation is to be performed. Some surgeons believe that it is safer to remove the member, if possible, above the affected bone, or at all events to remove the whole of the bone which is the seat of the disease. But some difference in procedure may be adopted according to the nature of the growth. In the central sarcoma it will probably be sufficient to amputate through the shaft of the bone, when the disease occurs at its lower end; and if it is of the myeloid variety and well localised to the part from which it sprang, a recurrence may very probably not take place. Indeed, some surgeons have deprecated amputation in these cases at all, and have advised simply scooping out the myeloid material and leaving the cavity to granulate up. Probably, however, the safer course is to amputate. In the peripheral variety of the disease, undoubtedly the wiser plan is to remove the whole of the bone from which the disease springs; and even then, only too often, a speedy recurrence takes place, either locally or in some distant organ.

The term osteo-aneurism was formerly applied to all tumours of bone which pulsated. But the majority of these are known now to be merely soft sarcomata, in which the pulsation is due to a large number of new vessels, or perhaps even mere channels or spaces filled with blood, in the new growth.

Osteo-aneurism.

The vessels in this growth, contained in a cavity with more or less rigid walls of unyielding bone, communicate a more or less forcible pulsation, which may cause the growth to be mistaken for aneurism. But there is nothing of an aneurismal nature about the disease, and the term is clearly a wrong one as applied to these growths. Occasionally, however, another class of cases are met with which much more resemble aneurism in their appearance, and are by some authors regarded as true aneurisms of bone; that is to say, dilatation of some vessel in the bone, expanding it, and presenting all the pathological characters of aneurism. They consist of hollow cavities, generally found in cancellous bone and filled with blood, sometimes partly fluid and partly solid. It seems, however, more than probable that, as Volkmann has suggested, these are merely sarcomatous blood-cysts, such as were described on page 351, consisting of a thin envelope of sarcomatous tissue around a central mass of blood.

There is still another form of pulsating tumour of bone, distinctly not sarcomatous, and to which the term osteo-aneurism is certainly more applicable than either of the other two above-described varieties. These are aneurisms by anastomosis, as they are termed, occurring in the substance of bone, generally the flat bones of the skull, and consisting of a congeries of dilated vessels massed together in a cavity in the bone. They have a distinct pulsation, and resemble in their symptoms the aneurisms by anastomosis occasionally found in the scalp, with the exception that they are lodged *in* the bone and not *on* it.

When a tumour of bone pulsates it will then most commonly be found to be a sarcoma of a very vascular character, or in which there are spaces communicating with the arteries which supply the tumour, and large enough to give rise to pulsation perceptible to the eye and the hand; or else it will be found to be formed entirely of dilated bony capillaries, just like the aneurism by anastomosis of soft parts. The pulsation is also, though more rarely, perceptible to the ear; and thus the symptoms resemble those of aneurism so very nearly that when the tumour grows in the neighbourhood of some large artery, as in the abdomen, near the course of the aorta or iliac arteries; in the buttock, near the gluteal; or in the femur, near the popliteal or femoral artery, the mistake has been committed by the most eminent surgeons, even after deliberate and repeated consultation, and that in both ways, i.e. aneurism has been mistaken for malignant tumour, as well as the reverse. I think this is sufficient evidence that in the present state of surgery the mistake is in some cases inevitable.¹ The main points of distinction between the two diseases are the following: Aneurisms usually have a distinct and loud bruit, pulsatile tumours none at all, or an indistinct one. Aneurisms have an expansive lateral pulsation (as well as the up-and-down pulsation), and this is not usually the case in pulsatile tumours. Aneurism does not affect the bone unless it has eroded or absorbed it (which is rare in the limbs); pulsatile tumours are hardly known except as springing from bones, and therefore incorporated with them. Aneurisms are often of longer duration than pulsatile tumours attain without fungating or destroying the patient's general health. It is by a careful consideration of all these symptoms that the diagnosis must be made; and in any case of doubt it seems the surgeon's

¹ Cases of erroneous diagnosis have been published in the case of abdominal tumour under Sir J. Paget's case, of gluteal under Mr. Guthrie's, of popliteal under Mr. Pollock's, and are referred to in a paper of mine, 'On the Diagnosis of Aneurism,' in the 7th vol. of the 'St. George's Hospital Reports.'

clear duty to give the patient the benefit of it, and to select the milder operation of ligature of the main artery in preference to amputation.

If the case is evidently one of pulsatile tumour of bone, amputation is, as a general rule, to be advised when possible; but there are pulsating tumours which can be eradicated with success, as is proved by the cases related by Sir J. Paget,¹ in one of which the tumour turned out to be of a fibrous nature, and the patient was known to have remained in health for ten years after its enucleation. In one other case a tumour, believed to be merely an aneurism of the bone, was successfully enucleated by the actual cautery.²

Such cases do undoubtedly justify the surgeon in proposing the removal of the tumour only when the latter is growing very slowly, so as to be evidently not malignant; and especially if there be so little evidence of solid tissue around the vascular mass that it may be hoped that it is a mere aneurism of the bone. In any such case, however, the patient should be prepared for amputation if necessary.

The innocent tumours of bone are cartilaginous (enchondroma), bony (exostosis), fibrous (fibrocystic), and cystic. Cartilaginous tumours, or enchondromata, have been spoken of above (p. 356) in their general aspect as they occur in other parts. They are, however, more common in the bones than in any other part, and they grow slowly, and often to a very large size,³ displacing all the structures of the part, but not infiltrating them, and showing no tendency to recur when completely removed. They are either multiple

Innocent
tumours of
bones.
Enchondroma.



FIG. 209. Enchondromata of the fingers and hand, from a cast in the Museum of St. George's Hospital. The patient was a lad about 15 years of age. There is a large tumour on the thumb, and a swelling of the end of the radius, due probably to the same cause.

or solitary, they either do or do not ossify, and they occur either in the diffused or the circumscribed form. It is the solitary and the circumscribed enchondromata which show the greatest tendency to ossification; the diffused and multiple enchondromata, such as are seen tolerably often on the phalanges (Fig. 209), show little or no tendency to the formation of bone; though in the process of time they degenerate into a low, calcareous, or fibro-calcareous formation, in which cysts are often found. Such enchondromata in the hand sometimes reach

an enormous size. Dr. Martyn⁴ has recorded one in which the weight of the hands became so great that the patient could not lift them, and in which the feet were simultaneously affected; but this is unusual. No treatment can be proposed in such cases except amputation, which is necessary when the hand or foot has become entirely useless. The tarsus would be

¹ 'Med.-Chir. Trans.' vol. liv. pp. 256-71.

² Mapother, 'Dublin Med. Press,' Feb. 4, 1863. In a case where Mr. Bickersteth amputated the leg for pulsating tumour of the tibia, the disease, on examination, was believed to be a pure example of osteo-aneurism, and no return took place. See 'Syst. of Surg.' 3rd ed. vol. ii. p. 320.

³ In Mr. Gamgee's case a cartilaginous tumour growing from the femur had attained so large a size that the limb after amputation at the hip-joint weighed 99 lbs. See Mr. Gamgee's 'History of a Successful Case of Amputation at the Hip-joint,' 1865, where similar cases of large enchondroma are referred to under the care of Mr. Frogley and Sir P. Crampton.

⁴ 'Path. Trans.' vol. xxii. p. 252.

left in the case of the foot, or a portion of it, if the extent of the disease prevented the formation of a flap entirely in front of the tarsus.

Cysts are also often found in enchondromatous tumours which show no trace of degeneration.¹ The structure of enchondroma is usually that of pure hyaline cartilage, indistinguishable from the normal tissue.

The diagnosis of enchondromata depends on their hard, lobulated surface (sometimes, however, with a certain amount of elasticity, if the cartilaginous tissue is soft, or if there is a cyst in the interior of the tumour), their slow growth, and the absence of all other symptoms. When they grow (as they often do) from the interior of a bone, the shell of the bone may be expanded over the surface, and may be felt to yield with a crepitating sensation. Generally there is little difficulty about the diagnosis, for the symptoms are usually quite different from those of cancer; there is not the hardness of exostosis, and the other innocent tumours of bone are very rare.

The treatment must be by amputation or enucleation. The former is required in cases of multiple enchondromata, when any treatment is indicated, in very large tumours, and generally when the operation for removal of the tumour would leave the member useless. Sir J. Paget² has shown how much better the prospects of recovery by enucleation are than used to

be believed; and since the publication of his paper amputation will be less frequently resorted to, at any rate without preliminary incision, in order to ascertain the nature of the tumour. If the whole bone is involved in the tumour it may be resected to the required extent; and this operation is especially indicated in the upper extremity. Two interesting cases by Mr. Lucas and Mr. Morris will be found in the tenth volume of the 'Clinical Society's Transactions.' In the latter a considerable portion of both bones of the forearm was removed, but the patient recovered with a useful hand. It is in such exploratory operations that the 'bloodless method' recommended by Professor Esmarch (see the chapter on OPERATIVE SURGERY) finds one of its most striking uses. Under the elastic bandage, properly applied, the tissue and the relations of the tumour can be studied on the living subject almost as easily as on the dead, and any vessels, nerves, or other important



FIG. 210. A cartilaginous tumour of the humerus, of two years' growth, springing from the compact tissue, and encroaching on the cancellous structure. It was removed by amputation at the shoulder-joint, and the patient was seen quite well two years afterwards. On microscopic examination the tumour was found to consist of large oval cells, with one or two nuclei, the wall of many being indistinct. These were closely packed in a finely granular matrix, which in some parts was dimly fibrillated.—St. George's Hospital Museum. Ser. ii. No. 176A.

¹ See a beautiful preparation in the Museum of the College of Surgeons, No. 203A, which is, I believe, Mr. Frogley's preparation, described and figured in the 'Med.-Chir. Trans.' vol. xxvi.; and in 'Syst. of Surgery,' 3rd ed. vol. ii. p. 322.

² 'Med.-Chir. Trans.' vol. liv. cases 1 to 3, pp. 254-55.

structures as easily dissected off the tumour. Such operations, however, will occasionally terminate in amputation—a contingency which must be provided for before commencing. I would refer to Fig. 210, which shows a very large enchondroma springing from the humerus outside the shoulder-joint. At the period of the operation the large size of the growth left to the operator no choice; but at an earlier stage of the disease it would have been a perfectly justifiable proceeding to have attempted the removal of the tumour alone, preserving the arm. Yet the operator might easily have been baffled in the attempt by finding the great vessels and nerves so buried in the mass that he could not hope for any usefulness in the member after the operation, and would find himself compelled to resort to amputation.

Exostosis, or bony tumour springing from a bone, is a comparatively common affection in some parts of the body, and occurs under three chief forms. Exostosis.



FIG. 211. Ivory exostosis of the lower jaw. There is no history, but the preparation has evidently been taken from the body of a very old person. St. George's Hospital Museum, Ser. ii. No. 191.

The first is the *ivory* or *hard* exostosis, which is composed of bone resembling the compact shell of the long bones or the external table of the skull, from which it often springs, but is even more compact, so that it exactly resembles ivory, no pores or bone-fibres being visible in its section. On microscopic examination these ivory exostoses show the lacunæ and the vascular canals of true bone, but the lacunæ are more irregularly distributed, and the vascular canals are more numerous and smaller than the Haversian canals.¹

This form of exostosis is met with generally in connection with the bones of the skull and face, and especially on the vertex of the skull and on the lower jaw (Fig. 211).² It never attains a large size except when it grows into one of the cavities—the orbit or the antrum. Its growth is very slow, and as a general rule such tumours are best left alone. Their removal is often extremely difficult, in consequence of their great hardness; and the violence which is necessary for this purpose involves very great danger, while the tumour can lead to no ill consequences, apart from the trifling deformity which it causes. But to this rule an exception must certainly be made in the case of ivory exostosis of the orbit. The gradual growth of such a tumour displaces the eye, causing blindness by the stretching of the optic nerve, and a very hideous squint. The base (which is usually attached to the inner or outer angle of the roof of the orbit) is often of no large size, and when fully exposed can be

¹ See 'Path. Trans.' vol. xvii. plate 13, for drawings and description of the microscopic examination of Dr. Duka's case of ivory exostosis, figured below.

² In the Museum of St. George's Hospital there is a specimen of one of these ivory exostoses growing from the scapula and projecting both into the ventral surface and also into the infra-spinous fossa. Ser. ii. p. 203.

partially cut through with a fine saw, and then broken with a few blows of a chisel and hammer. If the operation have not been too long delayed, the eye will return into position and sight will be restored. It is well not to go too near to the skull in making the section, though this must of course depend on the shape of the tumour's neck. Again, an exception may be made in ivory exostosis of the antrum. These exostoses often have very small bases, and are found to have undergone fracture at their neck and to be lying loose in the antrum. Such was the case in the instance which furnished the preparation represented in Fig. 212, and which occurred in a native of India, a patient of Dr. Duka.¹ On removing a triangular piece from the palatine



FIG. 212. A shows the general appearance, and B the appearance on section, of the bony tumour removed from the antrum by Dr. Duka, the account of which is to be found in the 'Path. Trans.' vol. xvii. p. 256. The position of the tumour during life was the reverse of that here shown.—St. George's Hospital Museum, Ser. ii. No. 191A.

process of the superior maxilla, the large mass of ivory-like bone here figured was found lying quite loose, its attachments having been separated either by the weight of the mass or by some accidental violence.

It may be mentioned, as some encouragement to the attempt to remove such tumours when it is otherwise indicated, that the tumour often has a much smaller neck than its size would lead one to expect, and also that the interior may be cancellous, while the exterior appears perfectly ivory-like. Such was the case in a remarkable tumour of the skull described and figured by Mr. Hott.² The patient had consulted many eminent surgeons, but all had shrunk from the apparent danger of removing it, believing that the neck was of great breadth, and of ivory-like consistence. On the contrary, when the patient died it was found that the tumour was of a mushroom-shape, the neck comparatively small, and the interior of the tumour wholly cancellous. The tumour might, therefore, probably have been removed with safety. On the other hand, many histories show the risks that may be encountered in such attempts. There are in St. George's Hospital Museum two preparations, one (Fig. 213) showing a small bony tumour with the marks of a trephine, with which and other instruments Mr. Keate strove in vain for more than an hour to take away the little lump, but was obliged to desist. The patient obstinately refused to submit to the slight deformity, and was ulti-

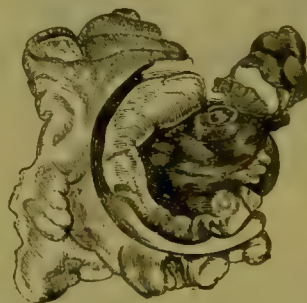


FIG. 213. Ivory exostosis, which was trephined unsuccessfully on account of its great hardness. Exfoliation was afterwards produced by the long-continued application of caustics, chiefly nitric acid. St. George's Hospital Museum, Ser. ii. No. 189.—From 'Syst. of Surg.' 3rd ed. vol. ii. p. 325.

¹ 'Path. Soc. Trans.' vol. xvii.

² Ibid. vol. iii. p. 149.

mately rewarded for his perseverance by its removal. Repeated applications of strong nitric acid and potassa fusa at intervals during several years produced its exfoliation, but at an expense of pain and danger quite disproportionate to the result. In the other case, Sir A. Cooper had tried to saw off a small ivory exostosis from the margin of the orbit, but in vain. This also exfoliated after repeated applications of caustic, and the marks of the saw are still to be seen upon the little tumour.



FIG. 214. A small exostosis of the femur, situated just above the internal condyle. The neck of the tumour, shown at the upper part of the woodcut, as well as a large part of the growth continuous with this (a), is composed of firm cancellated bone; the rest (b) of opaque white cartilage, composed of large cells, of an oval or circular form, closely approximated. The surface of the tumour (c) is covered by a thin incrustation of fibro-cartilage.—St. George's Hospital Museum, Ser. ii. No. 178.

posed of cancellous bone, is surrounded and encased by a layer of cartilage. The favourite seats of exostosis are in the neighbourhood of the epiphyses, particularly those of the femur and humerus, and on the extremity of the last phalanx of the great toe; but they occur in all parts of the body. They should only be removed in consequence of some symptom caused by their presence greater than the risk of removing them would be, for there is no doubt that, as a rule, if not always, their tendency is to stop growing. Hence on

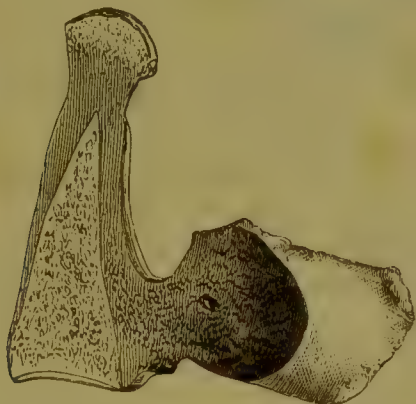


FIG. 215. Exostosis of the finger springing from the base of the first phalanx, in a man aged 58. The bone is seen to be healthy. The whole tumour is completely ossified into spongy bone, with the exception of a very thin layer of cartilage which covers its surface (on the unshaded portion of the diagram).—St. George's Hospital Museum, Ser. ii. No. 181.

often trifling, and which may be trusted not to increase. If the surgeon have made up his mind to operate he may be certain that the removal of

¹ The growth, however, in this situation, for some unexplained reason, is very liable to recur, and hence some surgeons recommend the removal of the distal portion of the phalanx from which it grows. See an interesting article by Mr. Southam, 'Med. Chron.' Feb. 1886.

² The knee-joint has often been opened in removing this exostosis, for in such cases previous attacks of inflammation may have enlarged the synovial membrane beyond its natural limits.

The soft or cancellous exostosis (Fig. 214) is a much more manageable disease, and operations for its removal are, at any rate under certain circumstances, justifiable. It grows either as an outgrowth, consisting primarily of bone, or as the result of the ossification of a cartilaginous tumour. In the latter case the internal tumour, com-

posed of cancellous bone, is surrounded and encased by a layer of cartilage. The favourite seats of exostosis are in the neighbourhood of the epiphyses, particularly those of the femur and humerus, and on the extremity of the last phalanx of the great toe; but they occur in all parts of the body. They should only be removed in consequence of some symptom caused by their presence greater than the risk of removing them would be, for there is no doubt that, as a rule, if not always, their tendency is to stop growing. Hence on the great toe, where the little tumour causes serious inconvenience in walking, and it can be removed with hardly any danger, this should always be done;¹ but when the exostosis is deeply seated (as in the very common instance of that which grows just above the internal condyle of the femur) and is near important structures,² it is very doubtful whether the patient is well advised in incurring any great risk in order to avoid inconveniences which after all are

the surface and the greater part of the neck of the tumour will perfectly suffice to stop the disease; no renewed growth need be apprehended. In the cartilaginous exostosis all the ossifying material is removed in such an operation, and in the bony outgrowth the remains of the neck never, as far as I know, are the origin of any renewed growth.

It has often been noticed that exostoses sometimes suffer fracture, and a remarkable case has been published¹ in which an exostosis of the femur, having been thus broken off from the bone, became entirely absorbed, so that a tumour which seemed at first to be of the size and shape of a walnut left no trace whatever of its existence; and Mr. Maunder, I believe, treated several cases by fracturing or dividing subcutaneously the neck of the exostosis. The treatment is eminently worthy of trial, though in the only three instances I have seen, under the care of Mr. Pick and myself, it was not successful. If the exostosis is not absorbed after the fracture of its neck, and its presence gives the patient inconvenience, it might be removed



FIG. 216. A diffused bony tumour of the lower jaw (diffused exostosis), removed with success at St. George's Hospital by Mr. Tatum. *a* shows the articular surface of the jaw; *b*, the symphysis. The operation consisted in the removal of the whole of that side of the bone. 'Path. Soc. Trans.' vol. ii. p. 95.—St. George's Hospital Museum, Ser. ii. No. 185.

when loose with far less danger than is involved in cutting through its base. Fig. 215 will illustrate the feasibility of this method of treatment. A tumour so large as this relatively to its neck could easily be divided from its attachment, either by fracture or by subcutaneous section with a chisel or fine saw, and passive motion might prevent any tendency to reunite.

The diffused bony tumour is illustrated by the accompanying figure (Fig. 216), showing a large lobulated mass of bone enveloping the jaw for a considerable distance, and only removable by extirpation of the whole of the bone from which it grows. Another and a very singular case is illustrated by a series of three preparations in the Museum of the College of Surgeons, in which, after amputation on account of such a tumour, situated near the knee, the tumour recurred in the stump, five years afterwards; re-amputation was performed, and then the disease again recurred in the pelvis. The tumour could not have been malignant, for the duration of the affection was no less than twenty-five years, and the patient died only of the local consequences of the pressure of the tumour.² Other similar cases have been noticed, and they bear a remarkable analogy to those of the recurrent fibroid tumour of soft parts.

¹ Dr. Chiene, 'Ed. Med. Journ.' July 1874.

² See 'Syst. of Surg.' 3rd ed. vol. ii. p. 327.

The other innocent solid tumours are rare, if we except epulis and fibrous or nasopharyngeal polypus, which are treated of in other chapters. They generally grow from the periosteum, and are of the fibrous 'fibrocellular,' or fibrocystic variety. Very commonly they are mistaken for enchondroma before operation; and as the treatment and the prognosis are the same, the mistake is of no importance, nor can I lay down any trustworthy rules for the diagnosis. The majority of such tumours seem to be connected with the femur.¹

Innocent
soft solid
tumours.

Cystic tumours of bone are serous and sanguineous. The former, if they are not confined to the jaws (as Mr. Stanley believed them to be), are at any rate only known in that situation, and these are in all probability always caused by some irritation around the teeth-cavities. They form sometimes enormous tumours in the jawbones (usually the lower), with the wall formed in some parts by thin crepitating bone, in others by fibrous tissue, and containing clear fluid. The diagnosis is easily made by puncture.

Hydatid
and other
cysts of
bone.

In other bones the presence of hydatids has given rise to the formation of cavities containing a thin fluid; but whether, independently of hydatids, serous cysts form in other bones seems doubtful.

Both forms require similar treatment, viz. to be laid open pretty freely, when if hydatids are found they are to be evacuated, otherwise the opening is to be kept free and the cyst left to fill up gradually. In a case which furnished a preparation to the Museum of St. George's Hospital, Sir B. Brodie removed the whole side of the lower jaw, on account of an unusually large cyst of this nature; but the operation proved fatal from erysipelas. I never saw one of so large a size, but have seen a few smaller ones which have done well under the simpler treatment.

The blood-cysts in bone are still rarer, and many of the cases were clearly only instances of malignant (sarcomatous) tumours, with blood-cysts of very large proportionate size formed in them, to which reference has already been made. I must refer the reader to the authorities named below² for illustrative cases. The treatment would generally consist in laying open and stuffing the cyst if no tumour-formation could be detected in the walls, otherwise in excision or amputation.

A very singular and rare affection in bones is known by the name of Mollities Ossium, Osteomalacia or Malacosteon. There is no doubt that under this designation several morbid conditions have been described, most of which constitute separate diseases, and have been noticed above. Thus bones become softened by the diffused form of infiltrating sarcoma.³ Again, bones have been known to be so softened by inflammation in the course of constitutional syphilis as to be described by the name of Mollities.⁴ And cases of spontaneous fracture from malignant deposit or from other causes

Mollities
ossium.

¹ See Adams and Hewett, in 'Path. Trans.' vol. v. p. 254.

² Travers, 'Med.-Chir. Trans.' vol. xxi. Stanley, 'Dis. of the Bones,' p. 187. Liston, so-called 'Ossified Aneurism of the Subclavian Artery.' 'Ed. Med. and Surg. Journ.' vol. xvi. pp. 66, 215. Nélaton, 'Path. Chir.' vol. ii. p. 48.

³ A good example of this is in the Museum of St. George's Hospital, showing two vertebræ completely softened by sarcoma, which has entirely replaced their natural structure.

⁴ The existence, however, of any softening of bones in syphilis so diffused as to deserve the name of osteomalacia is doubted by Lancereaux, 'Treatise on Syphilis,' trans. for 'New Syd. Soc.' vol. i. p. 243.

have been, incorrectly enough, spoken of as Mollities. But the peculiar disease which is properly so designated is marked by the gradual softening, bending, and very probably the ultimate fracture of the bones, usually of several parts of the body, or at any rate of a great extent of bone, while the patient is not in any visible condition of disease, except for the weakness and the loss of function which the softening of the skeleton produces. Mollities is, therefore, distinguished from sarcoma by the fact that in the one numerous and extensive tracts of bone gradually soften, bend, and perhaps ultimately break, while the deposit in sarcoma generally occurs at one definite spot, and the bone yields there abruptly, besides which there is often no fatal cachexia in mollities; in fact, in many cases the patient has died of old age. From rickets, to which it is compared by some authors, who speak of it as 'senile rickets,' mollities is distinguished by the essential feature that it has no tendency to recovery, while rickets always disappears if the child survives.

The symptoms of true mollities are very striking. The disease generally commences with pain mistaken for rheumatism, and sometimes this pain lasts long and is very severe. A great part of the skeleton, sometimes the whole pelvis or thorax, or many of the bones of the limbs, become so soft and weak that they bend under the ordinary muscular actions; till sometimes (as in the often-quoted case of Madame Supiot) the feet can be placed above the head, and the patient is quite bedridden from the weakness of the body; and the stature may even be much diminished from the falling together of the vertebræ. Fracture is very common, but, curiously enough, the bones may unite again. Dr. Ormerod published a case¹ in which there were a great number of fractures—at one time seven different bones were fractured—and yet the fractures united just as readily as they do in rickets. Often, however, the fractures show no tendency to unite. Most of the patients are past the middle period of life,² and are of the female sex, though men also suffer from the disease.³ Attention has been drawn to the fact that the bones of lunatics are more fragile than those of the sane, and this is believed to be due to a condition closely allied to mollities ossium, and is one in which the ratio of organic constituents to earthy matter is much greater, while the ratio of lime to phosphoric acid is distinctly less.⁴ Dr. Boddington believes that the softening is most common in motor-paralytic disorders connected with sclerosis of the nerve centres from increase of the connective tissue, such as general paralysis of the insane, paralysis agitans, and locomotor ataxy.⁵ Persons affected with this disease often die from mere decay of nature—sometimes from intercurrent disorders, as pneumonia; sometimes from deficient respiration, in consequence of the loss of mobility of the softened chest-walls, or from pressure on the spinal cord or medulla.

The pathological anatomy of the softened bones bears a considerable resemblance to rickets, and also to fatty degeneration. In some cases the fatty degeneration has been so extreme that the bone resembled 'rather a portion of fatty matter enclosed in a case of periosteum than a bone.'—(Ormerod.) At other times the outer shell has been healthy, while the central

¹ Brit. Med. Journ.' Sept. 10, 1859.

² One hitherto unique case was exhibited to the International Med. Congress in the skeleton of a child under two years of age. See their 'Trans.' 'Dis. of Children,' p. 59.

³ Out of 145 cases which Mr. Durham refers to, 13 only were men; but then in a great number of these, which are recorded only for obstetric purposes, the true nature of the disease is very doubtful.

⁴ 'Liverpool Medical and Surgical Reports,' vol. iv. p. 80.

⁵ 'Brit. Med. Journ.' Jan. 1871, p. 105.

cancellous tissue has been softened. The cancelli will be found enlarged, sometimes to such an extent that the whole bone is expanded and filled with a peculiar reddish gelatiniform matter, in which fat, oil, and blood-discs will be found, together with certain cellular bodies, according to Dalrymple.¹

Rindfleisch thus describes the microscopical appearances of bone in mollities: 'If we break off a minute trabecula from the cancellous texture of a bone affected with this disease, and after soaking it in carmine examine it under a magnifying power of 300 diameters, we find a highly characteristic set of appearances (Fig. 217). The trabecula is seen to consist of two different substances; it exhibits two very distinct zones—an outer one, lying next to the medullary spaces (*d*) and the Haversian canals (*c*), and an inner one, which forms the axis of the trabecula. The inner zone consists of perfectly normal bone-tissue; the corpuscles with their countless anastomosing prolongations, the highly-refracting colourless basis-substance, are unaltered. The outer layer, on the other hand (*b*), exhibits a finely striated basis-substance, deeply stained with carmine, in which only a few



FIG. 217. Mollities ossium. Splinter of bone from the spongy substance of an affected rib. *a*, Normal bone-tissue; *b*, decalcified bone-tissue; *c*, Haversian canal; *d*, medullary spaces; *d_v*, a medullary space filled with red marrow. — After Rindfleisch.

scattered streaks of shadow indicate the former position of the bone-corpuscles, while of their processes not a vestige remains; it seems rather as if a swelling of the intercellular substance were engaged in obliterating all the lacunæ together with their canaliculi. The alterations remind us too forcibly of those which the bone-tissue presents when soaked in hydrochloric acid to leave us in doubt for one moment that a process of decalcification is taking place in the present instance.'

The nature of the morbid change in mollities is by no means clear. The earthy base of the bone is absorbed, and much of it may be found passing away in the urine, but how or why this occurs we are at present entirely ignorant. That it is somehow associated with a generally depressed condition of the system, caused in some cases by repeated pregnancy, in others by mental suffering, in others by privation of various kinds, seems to be conceded,

¹ 'Dublin Quarterly Journ.' 1846. A very full account of the microscopical and chemical changes found in the bones in mollities is contained in Mr. Durham's paper in the 'Guy's Hospital Reports,' vol. x. 3rd series, 1864.

but nothing is known as to how this cause acts, nor why its effect should be so strikingly marked on the bones, while the rest of the body is unaffected.¹

A more interesting question is whether the disease is curable, and how to treat it.

Mr. Durham is disposed to answer the former question in the affirmative; and he is able to refer to two cases of alleged cure which rest on the authority of Beylard² and Trousseau. And in several other cases, which ultimately proved fatal, a considerable temporary improvement has been noticed under treatment. The treatment must be stimulant and supporting, as far as the digestion will permit; and the use of mineral acids, of course with due reference to the reaction of the urine, phosphates and cod-liver oil, seems to be indicated.

Many cases of deformity of the pelvis leading to difficulty in parturition are described in summary terms as 'mollities'; but the great majority of them have undoubtedly been instances, not of the disease here described, but of old rickets, though some have probably been cases of true mollities.

Rickets.

Rickets is a constitutional disease, the chief manifestations of which are found in the bones, but which implicates other organs, especially the great viscera—a fact which should never be left out of sight in speaking of or treating rickets.³ But the important peculiarity of the morbid diathesis in rickets is that it is not permanent. If the child survives, the disease will disappear, though the deformities produced by it will remain for life. And rickets is very rarely fatal in itself, although it is pretty often indirectly fatal; i.e. the child is so much weakened as to succumb to some infantile disorder which he would otherwise have thrown off. It may be combined with struma or congenital syphilis.

Rickets may commence, as it is believed, in utero, and is supposed to be one of the causes of intra-uterine fracture; but generally it does not begin till about the time when the child is beginning to walk, and often not till two or three years of age, or even later. Its causes are found in anything which produces weakness: bad feeding, bad air, want of cleanliness—poverty, in fact—are the common causes.⁴ Hence Sir W. Jenner says that rickets is the commonest constitutional disease among the children of the poor in London. But the children of the rich are not exempt from it, and in them it shows itself chiefly in the later members of large families, the mothers being

¹ I think it is a pity to waste space here on mere hypotheses. The reader will find them all stated and discussed in Mr. Durham's paper.

² Beylard, 'Du Rachitis, de la Fragilité des Os, de l'Osteomalacie,' pp. 266, 274. In one of these cases the person affected managed by gradual extension to increase her stature by half a mètre—i.e. more than eighteen inches—from what it was at the period of greatest curvature of the spine. The duration of the case extends over about twenty years, and the patient was then in good health, though deformed.

³ Sir W. Jenner has insisted, perhaps more strongly than any other author, on the constitutional origin of rickets. 'Med. Times and Gazette,' vol. i. 1860. Dr. Dickinson has described the enlargement met with in the liver and spleen chiefly, but also in the lymphatic glands, in rickety children as an increase in the fibrous and epithelial tissues of the organs, producing an appearance much like that of the ordinary lardaceous or so-called 'amyloid' degeneration, but not giving the characteristic reaction with iodine.—'Med.-Chir. Trans.' vol. lii.

⁴ A disease believed to be identical with rickets was produced in puppies by improper feeding.—Dick, 'Path. Soc. Trans.' vol. xiv. p. 289. Similar experiments with similar results were made by M. Jules Guérin.

exhausted by repeated pregnancies, or in the children of parents suffering from the hereditary taint of struma, or possibly syphilis.¹

The early symptoms of rickets are not always well-marked. The child appears restless and out of health ; if it has begun to walk it will be 'taken off its feet,' as the nurses phrase it ; its dentition is probably retarded, the breath foetid, and the digestion disordered ; but these symptoms are not in themselves conclusive. The first distinct indication of rickets is a swelling of the cartilaginous extremities of the long bones, and generally near the wrist or ankle, or of the ribs where they join with the costal cartilages. The child is usually also noticed to be restless and to throw off the bedclothes, and often the head sweats profusely. The fontanelles are often very late in closing and the head large. Now begins a stage of more or less general softening of the bones—those of the limbs become bent, the curves being generally an exaggeration of the natural curvature of the bone, and due partly to pressure in walking or crawling, partly to the traction of the muscles. Fracture is very common in the stage of softening, the fractures uniting very readily and kindly. In many cases the periosteum is not torn. Sometimes the bone is bent but not entirely broken. The chest-walls are distorted, the lower ribs being drawn in, somewhat as though a string had been tied round the chest above the liver. This distortion is due in part to the softness of the thoracic parietes, causing them to yield to atmospheric pressure ; for there is in these cases, as Sir W. Jenner has shown, a tendency to collapse of the upper part of the lungs, so that the external pressure of the atmosphere is not balanced by the air inside ; and the same result may be favoured by attacks of 'child-crowing,' or laryngismus stridulus, to which these weakly children are very liable. But the deformity is also due in part to the lower ribs being pushed out by the enlarged liver and spleen. And it may also be partly due to the diaphragm pulling inwards the parts of the ribs to which it is attached. The common 'pigeon breast' may also co-exist with this rickety deformity. The spine is not peculiarly liable to distortion in rickets. When this occurs it may take place in any direction, the most common, perhaps, being 'kyphosis,' or a generally diffused curvature backwards, easily distinguished from the abrupt, limited projection of angular deformity ; but 'lordosis,' or the forward displacement of the bodies of the lumbar vertebræ, may be produced by obliquity of the pelvis caused by the deformity of the lower extremities, or lateral curvature by unequal length of the two legs from a bend or fracture of one of them. The pelvis is often grievously deformed, its outlet being narrowed, the tuberosities of the ischia pressed towards each other, and the pubic arch widened, or the pubes pressed backwards towards the sacro-vertebral angle, and the ischia thrust outwards.² In other cases the pelvis is simply retarded in development, so as to retain in mature life the small

¹ An attempt has lately been made by M. Parrot to prove that rickets is merely one of the manifestations of constitutional syphilis. I have not space to enter into the discussion here, but cannot refrain from saying how much I dissent from the views of M. Parrot, which seem to me in flat contradiction to every-day experience, and to be founded too exclusively on pathological specimens and theoretical assumptions. The most that seems to me to result from M. Parrot's specimens and arguments is that rickets may exist along with hereditary syphilis, and that very probably a large proportion of syphilitic infants may be rickety. I would refer the reader who wishes to study the subject to the section on Diseases of Children in the 'Trans.' of the International Congress.

² I have before observed that many cases related in obstetrical works as instances of mollities were in all probability cases of deformity from rickets.

relative size of infancy.¹ This latter condition is connected with an interesting fact noticed by Mr. Shaw, viz. that in cases of old rickets the whole adult body often preserves the proportions natural to infancy—the relatively small size of the face, of the pelvis, and of the lower limbs—irrespective of any deformity in any of these parts.

The chief features of the pathological anatomy of the bones in the active stage of rickets are a large production of growing tissue at the epiphysial ends, a softening of the bony tissue of the shaft, with enlargement of the lacunæ, which are occupied by a red pulpy substance, and a great thickening of the periosteum.

There seems no doubt that the enlargement of the ends of the bones and the softening of their shafts, which are prominent phenomena in rickets, are due to the abnormal excess in the quantity, accompanied by imperfection in the quality, of the ossification. Thus, at the ossifying extremities (epiphysial cartilages) of the bones, the cartilaginous ossification is seen to be excessive in that the ossifying layer of cartilage-cells is very much increased in thickness; many of these proliferating cells are seen to be directly calcified; the embryonic medullary spaces are of very large size; and the basis-substance which separates them is permeated with calcareous salts forming an imperfect areolar or spongy tissue, the interstices of which, as well as the primary areolæ, are filled with a copious medullary (or embryonic) tissue; and according to Cornil and Ranvier the medulla which fills the medullary canal of the shaft itself is often organised into a kind of membrane. So, also, in the subperiosteal or membranous ossification the ossifying layer is much thicker, more ad-

herent to the bone, and forms a mass of spongy cellular substance in which irregular lines of calcification make their appearance, until it is converted into a layer of weak spongy bone much thicker, but also much less solid, than the normal compact tissue, which all this time is being absorbed from its lower surface in the natural process of growth. If the disease is cured without any alteration of the shape of the bone, all this is made good again, the swollen epiphysial ends resume their natural shape, and the spongy exterior is modelled down into the natural compact tissue. But if a bend occurs, the spongy wall of the bones is thickened still further in order to strengthen the curved bone, and its subsequent conversion into compact



FIG. 218. Costal node in rickets. The section represents the junction between a costal cartilage and a rib. A. Normal costal cartilage. B. Proliferating layer. C. Imperfectly calcified bone. D. A small spicule of periosteal bone. E. Laminated periosteum.

N.B. In the proliferating layer the matrix only, and not the cartilage cells, is represented.

¹ See Dr. Little's account of Mr. Shaw's researches on this subject. 'Syst. of Surg.' 3rd ed. vol. iii. p. 820.

tissue as the disease is cured forms those ridges or buttresses which are so familiar in rickety bones in the place of the *linea aspera* and other similar situations.¹

The effect on the skull is worthy of especial mention. The exuberant and imperfectly ossified tissue causes a great enlargement of the cranial bones, with disappearance of the distinction between the two tables and the diploe, till the whole skull presents a uniform thick layer of crumbly, porous bone. In the occipital bone, according to Rindfleisch, the pressure of the brain and counter-pressure of the pillow in lying often cause absorption, and so thinning, and even perforation, of the skull (*cranio-tabes*), now claimed by some observers as a symptom of congenital syphilis (see p. 414).

To the softening stage succeeds the stage of induration, in which the enlarged and bent bones ossify, and the patient recovers, but too often with permanent deformity from neglect during the early stages of the malady. Growth also in the severer cases is more or less stunted over the whole body.

The treatment of rickets is medical and surgical. The medical treatment is, no doubt, the most important, and if commenced early enough and carried through with care it usually makes all but the simplest surgical measures unnecessary. Great attention should be paid to the diet, to see that it is wholesome and sufficient, to the action of the bowels and skin, and to all other accessible hygienic measures. During the softening stage the child should be carefully nursed, and prevented, as far as possible, from crawling or walking. Cod-liver oil, iodide, and phosphate of iron, or other ferruginous tonics, usually procure rapid improvement of the health when combined with proper general treatment. But the misfortune of these cases is that the circumstances of the poor children often prevent them from having proper attention, diet, and regimen, or the ignorance of the parents and the easy assumption that the child 'will grow out of it' prevent them from applying for advice till deformity has far advanced.

The use of splints to the deformed limbs in rickets is not to be heedlessly adopted in deference to routine. It is useless to apply ordinary splints and bandages with a view to straighten the bent bones, except in the period of considerable softening, and then their application demands much care. If the pelvis is softened it is believed that the weight of the splints on the legs will increase the pelvic deformity. However, by careful splinting I have often succeeded in redressing incipient deformity, and have no doubt of the propriety of the practice. Another great benefit in splints is that they may be made to project below the feet, and so effectually prevent the child from walking—a great point with poor children who have no special nurses.

Knock-knee generally requires a special instrument, which must be carefully adapted to the individual case; and it must be remembered that in inveterate knock-knee it is not alone the ligaments that have yielded, but the shape of the bones is also altered, the internal condyle sometimes projecting below the level of the external, or the shafts of the long bones being changed in shape, so that only an imperfect cure is possible without the section of the deformed bone.

Finally, there are cases in which it may be justifiable to perform osteotomy, subcutaneously or otherwise, and put the leg straight, treating it somewhat like a compound fracture. The whole subject of osteotomy for rickety

Operations for rickety deformity and knock-knee.

¹ I would refer the reader for fuller descriptions to Rindfleisch's 'Path. Histology,' or to the work of Cornil and Ranvier.

deformities and for knock-knee will be treated in the chapter on Orthopædic Surgery.

Hypertrophy.

Hypertrophy of the bones is a result, in many cases, of chronic inflammation or sclerosis; but here the propriety of the term may well be questioned. Such cases are instances of chronic osteitis, and ought to be so described.¹ There are other cases in which no inflammatory symptoms are known to have ever been noticed, as in the skull which is preserved in the Museum of the College of Surgeons, enormously thickened, the history of which states that the patient was only made aware of the condition of the skull by finding that the size of his hat was constantly enlarging, though here the disease certainly resulted from injury. It is chiefly in the skull that specimens of hypertrophy are preserved in our museums, and as a rule nothing is known about the patients during life, except that many have been insane or of weak intellect. Some of these skulls are greyish in colour, very porous, irregular in structure—aptly compared by Mr. Durham² to dried mortar. Others, however, are much more dense and hard, though, like the former, 'they have a certain rough irregularity of texture.' The former are described under the name of 'osteoporosis.' The latter are regarded by Rokitsansky as instances of consecutive induration, succeeding on this osteoporosis. But Mr. Durham is inclined to doubt this, and to conjecture that the light spongy bones are examples of arrested mollities (which he regards as a curable affection), and the latter as the result of cured rickets. The idea must be regarded as a conjecture merely at present, but it is an interesting one, and deserves to be elucidated by further researches. Mr. Stanley has pointed out an interesting fact in the cases which he describes as hypertrophy of the long bones, viz. that the affected bone often increases in length.³ Sometimes the whole limb is lengthened, or when one bone (as the tibia) is affected and the other is not, either the affected bone will be observed to be curved, in order to adapt it to the normal length of the other, or the ligaments uniting the two bones will yield.

Atrophy.

Atrophy of bone ('fragilitas ossium') is not so much a disease in itself as a symptom of many other diseases, the chief of which are inflammation, fatty degeneration, ankylosis leading to disuse of the limb, and injury. Senile degeneration is also a frequent cause of atrophy—a fact illustrated by the fracture of the neck of the femur, spoken of on p. 292 (see Fig. 111). Atrophy, strictly speaking, consists in the mere removal of the tissue of the bone, with no alteration in its composition; and it is best illustrated by preparations in which, from ankylosis of the joints, or from prolonged confinement, the limb has become useless, and the bones are found to be light and papery, the compact shell greatly reduced in thickness, and the medullary cavity enormously increased in size by the disappearance of most of the cancellous tissue. Here the bone, if examined microscopically, would appear quite healthy. In practice, however, some amount of fatty degeneration usually accompanies atrophy, especially when due to old age. The rarefying stage of osteitis is a kind of atrophy, and this may be continued as a permanent condition. Such was the celebrated instance quoted by Norris,⁴ in which atrophy of the

¹ See Mr. Stanley's cases, *op. cit.* pp. 2, 3.

² 'Guy's Hospital Reports,' 1864, p. 380.

³ See also Paget, 'Surg. Path.' 3rd ed. p. 62.

⁴ 'Amer. Journ. Med. Sci.' Jan. 1842, p. 39. It is to this condition, as far as I can

humerus followed on fracture twice repeated, and where the whole bone disappeared, leaving the forearm 'swinging hither and thither like a thong,' and the arm shortened six inches. This can only be understood as being the result of chronic osteitis. In other cases atrophy after fracture is believed to depend on laceration or obstruction of the medullary artery of the bone.¹ The suspension of growth which follows on separation of the epiphyses, as well as the cases in which the epiphyses remain ununited, may be classed along with atrophy; and the absorption which follows pressure is, at any rate, closely related to atrophy. Thus it will be seen that as hypertrophy appears to be often only a very chronic stage of osteitis, considered as a productive process (sclerosis), so atrophy bears a similar relation to rarefying osteitis.

No treatment is known to have any effect on either of these pathological processes.

Spontaneous fracture is rather a loose term, the fracture being, in fact, always due to some slight force which would be insufficient to fracture a healthy bone. Its common causes are atrophy, malignant disease, mollities, rickets, necrosis (especially in its acute form), caries, and especially strumous deposit in the bone, whether accompanied by suppuration or no. To these causes we must now add, according to the recent researches of M. Charcot, disease of the nervous centres.² There are cases spoken of under the name of 'fragilitas ossium' in which there is a peculiar disposition to fracture, yet without any known atrophy of the bones, and in which the fractures unite in the usual manner; and it seems that the tendency may be hereditary. Mr. Greenish relates an interesting example of this in 'Brit. Med. Journ.' June 26, 1880. But such cases should be watched with some apprehension, for malignant disease may afterwards sprout out of the fractured part,³ or strumous deposit may make its appearance elsewhere. Spontaneous fracture from any cause does not preclude the possibility of repair, but in cancer amputation is required unless (as is very commonly the case) there are other cancerous deposits elsewhere. In all the other cases the surgeon should incline to preserve the limb; though in extensive necrosis, and especially in the lower limb, the attempt will very probably fail.

Spontaneous fracture.

understand, that Billroth has applied the curious name 'osteitis malacissans.' A few other instances of this inflammatory absorption have since been put on record.

¹ Curling, 'Med.-Chir. Trans.' vol. xx.

² Lectures on Diseases of the Nervous System. 'New Syd. Soc. Trans.' ii. 315.

³ A bone which gives way near a cancerous tumour may nevertheless unite. See 'Path. Trans.' vol. xi. p. 219. A man was admitted into St. George's Hospital with malignant disease of the humerus. The bone had given way at that spot ten months before, but the fracture had united before the tumour was noticed.—'Path. Trans.' vol. x. p. 249.

CHAPTER XXIII.

DISEASES OF THE JOINTS.

Disease
of the
joints.

DISEASES of the joints are described for convenience' sake under the head of the tissue thought to be chiefly, or at least most obviously, affected, and are therefore divided into diseases of the synovial membrane, of the cartilages, and of the articular ends of the bones. The classification is, no doubt, an imperfect one; in fact, the affections of the ligaments, including the fibrous capsule of the joint, are almost passed over in most of the formal treatises; though many surgeons believe that they are very commonly the starting-point of inflammation which destroys the whole articulation. It appears to me that one of the most useful ways of regarding the subject for practical purposes is to consider joint-diseases under two chief heads, viz. diseases originating in the bones and spreading outwards or towards the surface, and diseases originating in the synovial membrane or capsule and spreading inwards or towards the bones.¹ Another very important division of joint-diseases is into acute and chronic—a distinction which more than anything else governs our prognosis and treatment. Thus, cases will be met with, though fortunately not often, in which the disease comes on with very formidable symptoms—acute traumatic fever, rapid suppuration and disintegration of the joint, speedily terminating in death, either by exhaustion or by pyæmia; whereas the great bulk of the diseases of the joints which we are called upon to treat are accompanied by no constitutional affection whatever and involve no danger to life. They often cause loss of activity and of all that makes life worth having to the possessor, and from that consideration may justify operations which involve a certain amount of danger. But in making up his mind to perform such operations the surgeon should never omit the consideration that the disease exposes the patient to little or no danger, while the operation is attended with a certain risk. Those surgeons who use this as an argument for never performing amputation or excision in chronic joint-disease are, in my opinion, wrong, since the natural cure often takes many years, during which the patient, if a poor man, is debarred from earning his livelihood, and in any case from all enjoyment of his life; but there is no doubt that such operations are always to be regarded rather as operations of expediency than necessity. This does not, of course, apply to cases in which the suppuration is visibly pulling the patient down, or in which hectic has set in, and where the surgeon has reason to fear that the delay of amputation or excision may involve danger to the patient's life.

Synovitis.

The symptoms of acute synovitis are pain, inflammation (as shown by increased heat of the part), and fluid effusion into the synovial capsule. The disease is due either to injury or to rheumatism in most cases, and the pain varies accordingly. It is usually distensile and burning in the most acute cases, but is not complicated with those painful spasms which are characteristic of the more deeply seated affections. In cases of acute

¹ See 'Surg. Treatment of Children's Diseases,' 2nd ed. p. 411.

synovitis, the synovial membrane is injected and its capillaries are distended, the synovial fringes show cells in process of proliferation, and with distinct nuclei in which one or more nucleoli are perceived. The synovial fluid is found to contain a number of cellular elements—emigrated leucocytes intermixed with shreds of lymph. Cornil and Ranvier describe in the protoplasm of these cells fatty masses which are sometimes so abundant as to obscure

all the rest of the cell. The number of these cellular elements corresponds to the greater or less turbidity of the fluid. In chronic cases the effusion may resemble the natural synovia in all other respects, but is much more in quantity. Flakes of inflammatory exudation (likened by Cornil and Ranvier to sputa) are generally to be found in the fluid, and under the microscope the cellular elements are seen to be enclosed in a fibrinous network. Detached and disintegrated epithelium may also be found in the fluid, and more or less blood

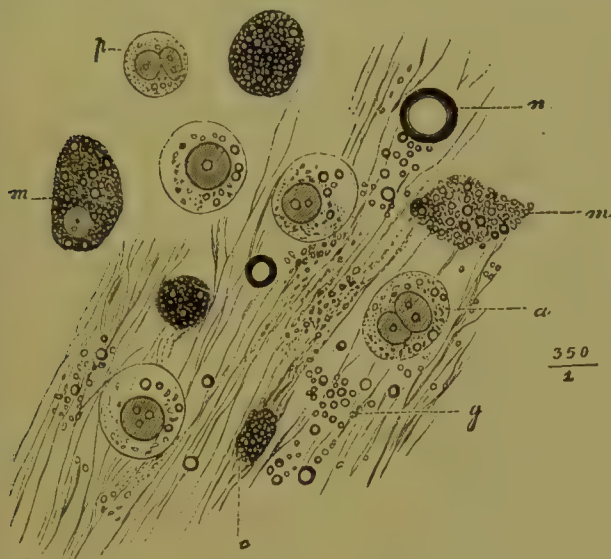


FIG. 219. Mucous and fibrinous elements of the fluid in acute rheumatic synovitis. *a*, a large cell; *m*, granular bodies resulting from the fatty transformation of the cells; *n*, drop of free fat; *p*, globule resembling pus; *g*, fibrinous network enclosing the cells and fatty masses.—From Cornil and Ranvier.

in some acute cases. In very acute cases the synovial membrane has been found partly destroyed by ulceration. In recent acute cases, before the sac has become too tense, the sense of fluctuation is very plain, and the form of the swelling, taking as it does exactly the shape of the synovial membrane, is perfectly characteristic. Thus, in the knee-joint there is a fluctuating swelling extending up the limb for some distance in front of the femur, bulging on either side of the patella, more prominent on the inner side, and floating the patella up as if in a water-bath. On the other hand, the shape of the swelling which is due to enlargement of the bones, or of the fibrous tissues which invest them, is an exaggeration of the natural outline of the bones. It raises and pushes forward the patella, but that bone remains still in contact with the femur. This form of swelling also is never developed so rapidly as synovial effusion often is. But it must be remembered that some amount of periosteal effusion or swelling of the bones themselves is often mixed with synovitis.

Mr. Morant Baker¹ has called attention to the fact that 'in cases of effusion into the knee-joint, and especially in those in which the primary disease is osteoarthritis, the fluid secreted may make its way out of the joint, and form by distension of neighbouring parts a synovial cyst of large or small size.' And he gives some striking drawings and cases showing that such cysts may form not only in the situations of the common bursæ, but also in comparatively remote parts of the leg, 'not approaching within 3 or 4 inches of any part of the knee-joint,' and not having any perceptible communication with it, and also showing that they may entirely disappear. The obvious inference

¹ 'St. Bartholomew's Hospital Reports,' vol. xiii. p. 245.

is that such cysts should not be punctured or otherwise submitted to operation without strong reasons.

The causes of synovitis are blows and sprains, exposure to cold, rheumatism, gout, gonorrhœa, and pyæmia or blood-poisoning. Gonorrhœal and pyæmic synovitis will be found treated of under the diseases of which they are symptoms. The surgical treatment of gouty synovitis is much the same as that of the rheumatic form of the disease. Cases also occur of syphilitic affection of joints in which the synovial membrane becomes implicated, but secondarily to affections of the bones or fibrous structures.

The usual course of synovitis is towards recovery, if the parts are left at rest. There are, however, exceptional cases, and chiefly those following on penetrating wounds of the joint, which will go on to suppuration and disorganisation (so-called 'abscess') of the joint. Using still the knee-joint for illustration, the symptoms of such abscess are as follows: High traumatic fever, rigors, great pain and starting of the limb, œdema and inflammation of the soft parts covering the joint, with considerable rise of local temperature, exquisite pain on motion; and if the part be not well supported, displacement of the bones of the leg backwards will rapidly ensue.

Acute
abscess.

Acute abscess is a formidable malady, due very commonly to injury, though it may occur spontaneously in weakly young persons. The abscess may either commence in the soft tissues around the joint, bursting into its cavity and causing rapid disintegration, or in a wound of the joint, or in acute synovial inflammation, or as the consequence of an abscess which, forming either in the bone or in the thickness of a degenerated synovial membrane, has made its way into the cavity of the joint.

The treatment ought to be decided, and for that purpose an exact diagnosis is necessary. This must be made by an exploratory puncture, for which the aspirator is the most convenient instrument. Should the fluid be only slightly purulent, or should there be no pus at all, there will be no harm in withdrawing the whole or greater part of the fluid, and carefully closing the puncture; but if the joint contains pus pure, or nearly so, an exit must be given to it by a free incision and passing a drainage-tube through the joint. Since the introduction of antiseptic measures the treatment of abscess, or entire disorganisation of the large joints by free incision, has become much more successful; and many of these cases have been brought to a favourable issue by laying the joint open as freely as in an excision, and treating the wound on the antiseptic method. After incision of the joint, if things go well, the joint will ankylose—in early life perhaps so incompletely that considerable motion will be preserved. Indeed, in one case of a child in whom I opened the knee-joint very freely hardly any impairment of motion was perceptible after her recovery. But in adults the joint will usually be stiff.

If the case is to do badly the fever increases, the discharge becomes more foul, and the limb more swollen and painful. If the surgeon has made a small puncture he may be inclined to try the effect of freer incisions, failing which his only resource is to amputate; but amputations under these circumstances are very unpromising, and, if definite symptoms of pyæmia have set in, are almost hopeless.

Treatment
of syno-
vitis.

In the acuter forms of synovitis the effect of local blood-letting is generally very beneficial. The fluid may often be withdrawn through an aspiration-puncture with marked benefit. Mr. Barwell strongly recommends a subcutaneous incision into the synovial membrane, if the fluid is too thick to flow

through the needle. The limb must be put up in an apparatus which will keep it perfectly at rest, for which purpose, in the case of the knee, some support must be given in the ham by means of a pad or stuffing, or by a bend in the splint. Ten or a dozen leeches may be applied, and the bleeding encouraged by fomentation afterwards, and then cold must be assiduously employed; or, if cold is not well borne, the application of a large poultice enveloping the limb is often very grateful. 'Leiter's tubes' form a very convenient method of applying cold (see page 16). In many cases, if the morbid action is not too acute, the pressure of an elastic bandage is very useful, and the cold can, if necessary, be applied outside this.

For more chronic cases, or when the acute has given way to chronic inflammation, complete local rest and blistering are the measures chiefly indicated; and in the last stage of the disease, when little is left except a little indolent swelling, pressure is very useful. This is often made by a case of strapping, inside which a layer of camphorated mercurial ointment is placed, and the whole supported by a bandage, which can be gummed if necessary (Scott's Bandage); but strapping and bandage in the ordinary way answers well enough. When the patient discards this and gets about without any application, gentle shampooing and friction will be useful in removing any remains of swelling.

To the most chronic form of synovial effusion the name of 'hydrops articuli' has been given. It forms a large fluctuating swelling devoid of heat or pain. It is almost confined to the knee-joint, and the patient requires relief from the condition on account of the stretching of the ligaments and consequent insecurity of the joint, rendering the limb useless. The fluid differs from that of common synovitis in containing little, if any, lymph; but it coagulates with heat, like the fluid of hydrocele. The limits between chronic synovitis and hydrops articuli are difficult to fix; consequently, if there is any prospect of improvement from the milder methods of treatment used in chronic synovitis—rest, blistering, pressure, absorbent ointments, and aspiration—a careful trial must be given to such measures. But when these have failed, or if the complaint is so inveterate as to render them obviously useless, the joint must be injected with iodine. The tincture of iodine has been injected in equal proportions with water, ℥ss. of the mixture, or ℥iij.—iv. of a weaker solution—one part of the tincture to four of water—as much of the fluid as possible being allowed to escape afterwards. Care must be taken to exclude the air, and the puncture must be carefully closed, and strapping and bandage applied on a splint. If severe reaction follow, as may easily happen, the case may be converted into one of acute abscess. But generally it does well and the patient recovers, with more or less stiffening.

Hydrops articuli.

The synovial membrane becomes more or less thickened in all cases of chronic synovitis, but this thickening disappears in the course of time, and no remains of the disease are to be found ultimately in favourable cases. It does happen, however, not uncommonly that the swelling persists as an indolent pulpy thickening. This constitutes the disease to which Brodie gave the name of pulpy degeneration of the synovial membrane. It is a disease which, though commencing in the synovial membrane, affects eventually all the tissues of the joint, and usually terminates in complete destruction of the articulation. It occurs in strumous children, and to it the name of 'tubercular arthritis' is now very commonly applied. The evidence that this disease is tubercular in its nature is by most of the pathologists of the

Pulpy degeneration of synovial membrane.

present day regarded as quite conclusive. Many observers in this country and Germany have found undoubted miliary tubercle scattered through the granulation tissue, which, as we shall presently describe, replaces the synovial membrane (Fig. 220). Whether, however, the development of tubercle is the original disease, or whether a chronic inflammation precedes and alters the structure and condition of the synovial membrane, and so prepares a suitable nidus or soil for the implantation and growth of the tubercle, is not yet quite certain. Probably the latter is the case; for Croft¹ describes three zones as being usually distinguishable in this condition in the thickened synovial membrane: i.e. a superficial caseous zone; a zone of tubercular infiltration, usually forming a large proportion of the entire mass; and a zone consisting of the fibrous structures of the synovial membrane in a state of chronic inflammation. From which it would appear that the inflammatory process precedes that of tubercular infiltration; though it is but right to state that Croft found even in the zone of inflammatory thickening isolated tubercular granulations. Moreover, this view would accord with what has been said of tubercular deposit in another place

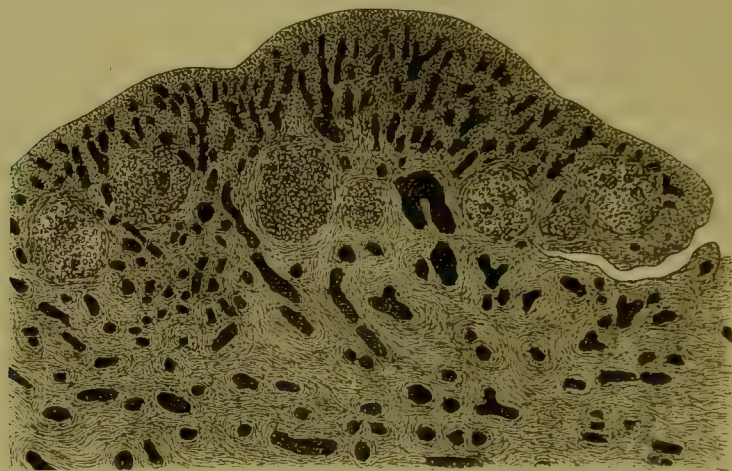


FIG. 220. Miliary tubercle of the synovial membrane, from a case of tubercular arthritis. For a sketch of a more highly magnified portion of the same preparation see Fig. 181, p. 384.—By Dr. S. Déjépine.

(p. 386), that chronic inflammation is one of the exciting causes of this disease, so altering and modifying the tissues as to render them suitable for the reception and propagation of the virus. The various stages in the pathology of this disease as seen with the naked eye have been well described by Billroth. The first change is swelling and redness of the synovial membrane, and its villi become thickened, soft, and moist. The synovial fluid is, in this early stage, but little increased in quantity; but what there is is altered in quality, being somewhat turbid, and resembling muco-pus. As the disease advances the synovial membrane becomes thicker and the villi grow and fill up the spaces between the articular surfaces. They now begin to assume the appearance of granulations, and begin to creep over the cartilages between the articular surfaces. This thickening and growth of the synovial membrane and its fringes is due to a gradual replacement of their normal structure by granulation tissue, which first infiltrates and then destroys and takes the place of the original tissue of the part, so that no remains of the normal structure are left. If now examined, the synovial membrane is found to be converted into a pulpy, gelatinous, pinkish-grey mass, which even to the naked eye resembles

¹ 'Path. Soc. Trans.' vol. xxxii. p. 181.

granulation tissue. All the other structures of the joint subsequently become involved. The granulation tissue gradually creeps over the cartilage 'like ivy over a wall'; then it becomes attached to the cartilage, and gradually eats it away and replaces it; so that if one of these processes be examined, it will be found at its extremity to be lying loose on the cartilage; a little nearer the root, it will be connected with the cartilage; and still further back, it will be seen to have eaten its way into the cartilage, and a little pit or erosion in this structure will be left if the tissue is removed. In this way the whole of the surface of the cartilage will become covered with a layer of granulation tissue, by the confluence and blending together of the processes; and the tissue on the opposite surfaces of the joints becoming massed together, the cavity is obliterated. As it covers the surface of the

cartilage it destroys it, and soon, having perforated it, it spreads on its under-surface between the cartilage and the bone and attacks both structures, eating away the cartilage on its under-surface until it meets the tissue growing from the upper surface, and thus destroying every vestige of this structure. It also extends into the articular lamella of bone, and consumes this and the sub-jacent osseous tissue by a process of rarefying osteitis. Coincidentally with these changes in the bones and cartilages, the capsule and ligaments of



FIG. 221. Pulpy degeneration of the synovial membrane. *a*, the patella. *b*, the condyloid extremity of the femur. *c*, the articular surface of the tibia. *d d*, the pulpy mass, partly overlying and concealing the articular cartilages. The latter are generally intact, but in a few places they show incipient ulceration.—From a case in which amputation of the thigh was performed in view of the general condition of the child's health.

the joint become involved. They become thickened, cedematous, and infiltrated with inflammatory products. The parts in the neighbourhood of the joint participate in the inflammation, and when the bones become affected the periosteum usually shares in the disease. The inflammation here is of the osteoplastic variety; so that while the joint is being destroyed within new bone is being formed externally, by the formation of osteophytic out-growths which have a jagged form, like stalactites. Many cases occur, however, in which no osteophytes are formed.

After the granulation tissue has attained a certain thickness, it begins to degenerate from malnutrition, from want of sufficient blood-supply, and undergoes a fatty change, or caseation, and finally softens and breaks down, and forms an abscess filled with curdy pus; so that often, while the changes above described are going on, small abscesses may be found scattered through the substance of the altered synovial membrane. Finally, however, if the disease be left untreated, the suppurative process implicates more or less entirely the whole mass of granulation tissue, and abscesses form and burst externally, so that the whole of the joint is converted into a suppurating cavity containing the remains of broken-down tissue, and surrounded by the carious

extremities of the bones entering into its formation. Suppuration is, however, by no means an absolutely certain result of this form of disease. Extensive destruction of the cartilages and bones may take place; the ligaments may be softened and destroyed, so as to allow of the displacement of the articular surfaces from each other, and still not a drop of pus may form.

The symptoms of pulpy degeneration of the synovial membrane are usually, at their onset, of a very insidious character, and may have existed for some time without serious attention having been drawn to the affection. The child in the first instance may be noticed to limp in his gait or walk slightly lame; at the same time he may complain of pain in the affected joint, especially after exercise or exertion. These symptoms, however, are not so severe as to attract, may be, marked attention; the lameness is attributed to a bad habit; the pain complained of, to 'growing pains,' and so the disease is allowed to go on. Should, however, the surgeon be called to such a case, he will find, probably, some limitation in the movement of the joint; that is to say, though the ordinary motions of the joint appear to be free enough, there will be some impairment in the extreme movements of the articulation. Thus, in a hinge joint, for instance, it will be found, on comparing the powers of flexion and extension with those on the opposite side of the body, that they are somewhat restricted. At the same time the surgeon will generally find slightly increased heat about the joint. Soon some enlargement of the part takes place, at first due to effusion into the synovial sac, and taking the shape of this membrane; afterwards, when the capsule of the joint and surrounding structures have become implicated and infiltrated, the swelling becomes globular in shape: it is elastic to the feel, and presents no discoloration or redness, the skin being white and pasty or waxy in appearance. It is these two prominent symptoms which have earned for the disease the popular name by which it is known, 'white swelling,' and which so well describes its characteristics. Another important sign, which is often of value in coming to a diagnosis if any doubt exists as to the nature of the case, is muscular wasting. During this stage there is little or no constitutional disturbance, and the patient's health does not appear to suffer in any way. As the disease advances the joint becomes semiflexed and the limitation of movement more marked. After the ligaments have become involved partial displacement may take place. Thus, in the knee-joint, in which the symptoms of strumous disease are well illustrated, the bones of the leg are not uncommonly displaced outwards and backwards, and at the same time rotated outwards by the action of the biceps muscle, the ligaments which extend into the formation of the joint being so weakened and softened by the morbid process going on in them as to be unable to resist the reflex contraction of this and the other hamstring muscles. The disease in the joint may now be arrested, with a limb permanently crippled. Should it continue to progress, pain on use is increased; starting of the limb sets in at night, and evidence of suppuration begins to show itself. There is increased heat about the joint; the swelling becomes more prominent at one point, and the skin over it becomes reddened. Fluctuation then becomes perceptible, and finally the abscess bursts or is opened. During this period the constitutional symptoms are still only slight; but in most cases there will be found to be a slight nocturnal rise in the temperature, and the child's health begins to deteriorate. After the abscess has burst it generally contracts and forms a sinus leading into the disintegrated joint. Other portions

of the granulation tissue now, in like manner, soften and suppurate, and fresh abscesses form; so that soon the tissues around the joint are riddled with sinuous suppurating tracts, leading down to exposed and carious bone, and a general condition of exhaustion and hectic sets in, or a tubercular condition of some other organ, as the lung, may supervene and terminate the existence of the patient.

The treatment of the earlier stages of strumous disease of joints resolves itself chiefly into maintaining the articulation in a perfectly immobile condition. Rest to the joint is the most essential constituent in the treatment of this affection, and without it all other treatment will be futile. By this means alone many cases may be brought to a successful termination; but, in order to succeed, the rest must be complete, and must be persevered in for a very considerable length of time; that is to say, the joint must be fixed in some immovable apparatus which will entirely prevent any movement of the articular surfaces on each other, and, if the disease is in the lower extremity, the weight of the body must not be allowed to bear on the affected part. Of course, if the disease is in the upper extremity, this is easily attainable. The arm can be placed in a sling if the elbow or wrist is affected, or bound to the side if the shoulder-joint is involved, and the patient allowed to go about. In the lower extremity, however, there is more difficulty, and this it is which renders the splints devised by Mr. Thomas of Liverpool for the hip and knee of so much value in the treatment of these cases. By means of these splints the affected joint (hip or knee) is kept immovably fixed, and still the patient is able to go about on crutches, with the leg raised from the ground, so that no pressure from the weight of the body is made on the diseased articulation. The same end may be obtained by applying a well-moulded leather splint to the part, which should be sufficiently long to prevent all movement of the joint. A clog or patten is at the same time to be worn on the other foot so as to raise the affected limb from the ground, and the patient allowed to go about on crutches (see Fig. 228). If the disease is in the ankle or tarsus, the same end may be obtained by a knee-rest with a wooden leg. A very useful appliance in these cases is Scott's Bandage, which not only maintains fixity of the joint, but also steady, gentle pressure with the absorbing effects of the mercurial ointment. Occasionally, also, counter-irritation is of service; the light application of the actual cautery once a week, or repeated blistering to the joints, appears sometimes to have a beneficial effect, but is only of use in quite the early stage of the disease. At the same time the patient's health must be carefully attended to, and plenty of fresh air is a first requirement.

The rest, to be of any use, must be maintained for a very considerable length of time; six, nine, or twelve months is no uncommon time for it to be required, and even, if the disease is of long standing, a longer period than this may be necessary. Care must be taken also that movements in the joint are not permitted too early after the subsidence of all symptoms. As Mr. Howard Marsh wisely insists, 'rest should be maintained, as a rule, for at least three months after all signs of disease have disappeared, and active exercise should be very gradually renewed.'

During the whole of this protracted treatment the child's general condition must be carefully attended to, and his constitutional state treated on those principles which have been laid down in the chapter on Scrofula. When, in spite of treatment, the disease continues to progress, or when the third stage is reached, and suppuration has declared itself or is threatening,

the joint should be at once opened and the whole of the diseased synovial membrane dissected away. This operation, which is named 'eration' or 'arthrectomy,' has been strongly advocated by Mr. G. A. Wright of Manchester in cases of disease of the knee-joint, and appears likely to supersede in a considerable number of cases of this class the old operation of excision. Mr. Wright thus describes the operation: It 'consists in opening the joint freely, . . . carefully cutting away with forceps and scalpel or scissors every particle of pulpy granulation tissue, all the infiltrated capsule and the semi-lunar cartilages, and scraping quite clean all the articular cartilage, picking out granulation tissue from any pits in the cartilage, and, if necessary, gouging away any small spots of diseased bone. The process must be most thorough, and extreme flexion of the limb is required to completely expose and clean the posterior part of the joint; the crucial ligaments are scraped but carefully preserved, the lateral ligaments usually divided.' This operation aims at removing the diseased structures and the diseased structures only; and it is now a recognised fact that degenerated synovial membrane, when it has been thoroughly infiltrated and destroyed by the chronic inflammatory process above described, requires removal as much as carious bone. But at the same time, though the operation should be done with as much thoroughness as possible, it does not appear to be necessary to remove every vestige of diseased tissue in order to bring about a cure. And we have in certain drugs means of destroying any particles which may be unable to be reached or may escape the surgeon's instrument. Of these the most important are iodoform, chloride of zinc, and corrosive sublimate. The first of these is believed to have a direct specific influence on the tuberculous materies morbi, whatever this may be. In these cases, therefore, after all parts of the infiltrated synovial membrane have been removed as far as possible, the surfaces of the joint should be thoroughly washed over with a solution of chloride of zinc (40 grs. to the ounce), or irrigated with corrosive sublimate solution (1 in 1,000), and then iodoform dusted into all the recesses of the joint and over the surface of the wound.

The advantages of this operation are, that it leaves the patient without shortening of the limb, and without deformity such as must result when excision is performed. In some cases also he may have a certain amount of movement in the articulation; though, as a rule, it will be found to be better for the patient's welfare not to attempt to obtain this by early passive motion.

If there is much disease of the cartilages and bones, so that the above method of dealing with the case cannot be adopted, excision will be the appropriate treatment; unless, indeed, amputation is called for by the health and condition of the patient, or by the extent of the disease rendering excision impossible.

Pendulous
growths
from
synovial
membrane.

In some cases the synovial membrane is found studded over with a number of loose pendulous fringes. A most beautiful preparation exists in the Museum of St. George's Hospital, which has been figured in various works on the joints, and which shows this condition in its highest grade. The growths are variously regarded as being the products of simple inflammation or as one of the phenomena of rheumatic arthritis. Probably both views are correct in different cases. Certainly, such pendulous growths may form, isolated or in small numbers, in simple inflammation, and may become loose in the joint (loose cartilages); while Dr. R. Adams has given good reasons for believing that in one at least of Sir B. Brodie's preparations of this condition the disease was of the nature of rheumatic arthritis, since the state of the

cartilages and bones and the history exactly corresponded with the usual phenomena of that affection.

Disease of the articular ends of the long bones is a frequent cause of the strumous disease of joints above described; and it is impossible to decide clinically, in any given case, whether this disease begins in the synovial membrane, as above described, or as a fungating caries in the ends of the bones. When it begins in the latter situation, the joint is of course at first free, but very soon the cartilages become perforated, and the changes above described as taking place in the synovial membrane become apparent, and it is impossible to decide by clinical evidence in what structure the disease began, since the symptoms of synovitis completely mask the primary bone disease.

Diseases of the articular ends of bones.

In addition to chronic inflammation of the ends of the long bones leading to 'strumous disease of the joints,' a form of acute inflammation, probably of an infective nature, and closely allied to osteomyelitis, is occasionally met with in young children, and leads to acute inflammation of the joint. The disease has received the name of *acute epiphysitis*, and the cause of the affection is not very manifest, though it is frequently attributed to injury. There is enlargement of the bone end, with pain on pressure, and redness of the skin. This is soon followed by effusion into the joint and very great constitutional disturbance. Upon examining the diseased bone it will be found infiltrated with pus, separated from the shaft of the bone, and lying in a bag of pus, which communicates with the joint by a perforation in the articular cartilage (see p. 439).

Acute epiphysitis.

In the treatment of this affection the limb must be kept at perfect rest by means of a splint. In the early stage of the disease the application of a few leeches, followed by hot fomentations, will often relieve pain. As soon as matter forms, a free incision must be made, and the epiphysis perforated, and free exit given to the pus. In many cases, however, amputation will be necessary.¹

Mr. T. Smith has shown, in a very interesting paper,² how frequently the ends of the bones are the seat of disease in the earliest periods of life. The disease consists in an infective inflammation of the epiphysial cartilage; due, it is believed, in some instances to septic absorption from the umbilical cord, in others to injury. The inflammation rapidly runs on to the formation of pus, involves the epiphysis, which becomes separated from the shaft of the bone, bursts into the joint, and quickly destroys it. The symptoms are pain and swelling, with acute fever, followed by the rapid formation of matter. Sometimes more than one joint is affected, and most of the cases terminate fatally in a few days. If, however, the abscess is opened early and carefully drained, and the child's strength can be maintained, recovery may take place; though it is usually with a flail-like joint, the ends of the bone being united by loose fibrous tissue.

Acute arthritis of infants.

The disease to which the name of 'ulceration of the cartilages' was given by Brodie, and to which it is usually applied, is a very definite and easily recognisable affection, and one to which the designation is, doubtless,

Arthritis.

¹ An instructive discussion on the subject of necrosis of the epiphyses in childhood, based on a paper by Mr. Morant Baker, took place at a recent meeting of the British Medical Association, and is reported in the 'British Medical Journal,' Sept. 1, 1883. The reader will there find some interesting observations on various points connected with this subject, for which a work of this kind does not afford space.

² St. Barth.'s Hosp. Reports, vol. x.

so far appropriate that the cartilages will always be found to be ulcerated. But whether that ulceration is the essence of the disease, or only one of its invariable concomitants, may very reasonably be doubted. In my own opinion, and, I believe, in that of most surgeons of the present day, the affection of the cartilages plays really a very subordinate part in the disease.¹ The term 'arthritis' is now more generally applied to this affection, inasmuch as the disease, in whatever structure it begins, rapidly extends to all the other structures of the joint, which speedily become involved.

This affection is characterised by the usual symptoms of inflammation of the joint, but especially, and besides these symptoms, by the peculiar painful startings of the limb and the acute localised agony which is produced by pressing the joint-surfaces together, and in the worst cases by the slightest movement or jar communicated to the limb. The spontaneous startings occur usually at night, just as the patient is falling asleep; often they wake him from the deepest sleep, and they leave acute pain, lasting long afterwards, and accompanied sometimes by severe sweating. With these prominent and agonising symptoms there is often very little swelling or synovial effusion, though in other cases the symptoms of ulceration of the cartilages follow on a regular attack of synovitis, but more commonly the preceding symptoms are those of affection of the articular ends of the bones.

The after-progress of the disease is in one of three directions: (1) the symptoms may subside, leaving a little loss of motion at first, which afterwards almost entirely disappears in some cases and persists in others; (2) the joint may be dislocated, abscesses may form, leaving sinuses through which the bone is exposed, and the case pursues the usual course of chronic disorganisation of the joint; or (3) acute abscess may form in the cavity of the joint, in which case the patient usually sinks from pyæmia or irritative fever if the limb be not removed.

The pathology of this disease seems to be as follows: In the cases in which it commences as synovitis, the inflamed synovial membrane is converted into a pulpy mass, resembling, if not identical with, granulations. The granulations advance over the surface of the cartilage and replace it; so that when the inflamed synovial membrane is lifted from the surface of the cartilage little ulcerated pits are found, which have been worn into the cartilage by the granulations of the synovial membrane. The erosion spreads through the cartilage to the subjacent bone. In the more ordinary cases the course of the inflammation is the reverse. From the inflamed bone it spreads through the cartilage to the synovial membrane.

The appearances of inflamed cartilage to the naked eye consist in the formation on its surface of ulcerated spots where the cartilage is removed in a part or the whole of its thickness, and in a degeneration of its substance, which becomes fibrous (so as to be compared to the hairs of a small brush or to the pile of velvet), and in some cases thickened and softened in texture. The union also between the cartilage and the bone becomes much loosened, so that the cartilages are in some places quite detached, though still lying over the bone; or pieces of the cartilage may be detached and free in the joint.

¹ 'Nothing can be more sure than that, of all the joint-diseases which fall under the surgeon's notice, not one originates in the cartilage.'—Barwell, 'Dis. of the Joints,' 2nd ed. p. 399. 'There is no primary disease of this structure' (sc. Cartilage). 'All the changes that are to be found in it are secondary to some other affection, and in the generality of cases to disease in the articular extremities of the bone.'—Bryant's 'Practice of Surgery,' 2nd ed. vol. ii. p. 423.

Examined by the microscope, two kinds of change are seen in such cases. In one which is more distinctly inflammatory the nuclei of the cartilage-cell increase in size, and divide so as to increase in number; the contents of the

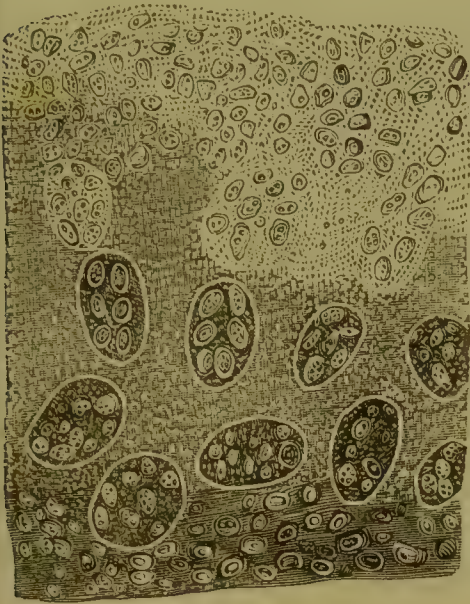


FIG. 222. Acute inflammation of cartilage.
After Redfern.

cell become granular; the cells enlarge at the expense of the hyaline substance, which is ultimately absorbed, and then the cells burst, setting free their contained nuclei, which have become transformed into bodies resembling pus-corpuscles. Fig. 188, p. 430, will show that here also, as in the bones, large many-nucleated cells are found which hardly look as if they had been formed by the proliferation of the cartilage-cells (as those in Fig. 222 are), but rather as if they had been formed in the medulla of the neighbouring bone and were engaged in eroding the substance of the cartilage. The same figure shows the intercellular substance calcified—a change very usually found, but the precise significance of which is not yet clear.

In the other change, which partakes more of the nature of degeneration, the intercellular substance is not destroyed, but is rendered granular, and the cartilage-cells are separated from each other by a fibrillated material, which

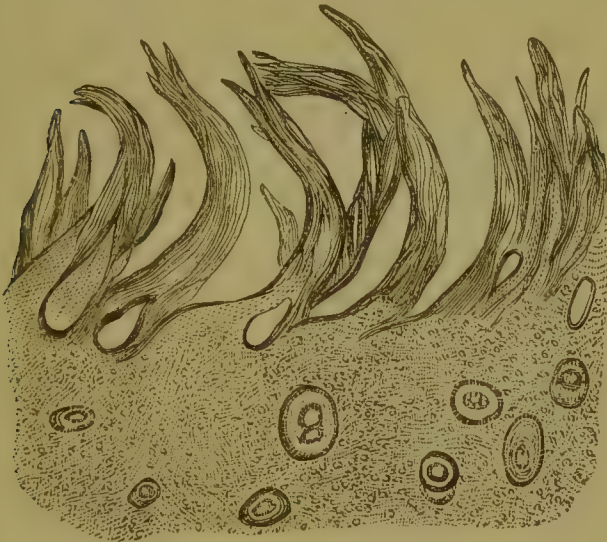


FIG. 223. Vertical section of inflamed cartilage, showing the splitting into fibres of its surface.—From Redfern.

is probably developed from the nuclei of the cartilage-cells by a process of proliferation. Rindfleisch¹ has depicted in these more chronic instances of inflammation canals extending through the cartilage from the granulations on the articular lamella to those on the synovial membrane, into which vessels shoot which bring these two layers of granulation into contact.

These more chronic changes depend, as it seems, partly on loss of nutrition from the loosening of the connection between the cartilage and the bone.

This slight sketch of the morbid anatomy of inflamed cartilage, which ought to be supplemented by a study of the works named in the footnote,² will, it is hoped, enable the student to understand what has been said about

¹ 'Pathological Histology,' New Syd. Soc. Trans. vol. ii. p. 260.

² Redfern, 'Abnormal Nutrition of Cartilage.' Barwell, 'Diseases of the Joints.' Weber, 'Ueber die Veränderungen der Knorpel, &c.' 'Virchow's Archiv,' Jan. 1858. Rindfleisch, 'Path. Anat.' vol. ii. pp. 250, 260. A. E. Barker, in 'Syst. of Surg.' 3rd ed. vol. ii. p. 348.

the symptoms and the results of the disease called 'ulceration of the cartilages.' The mere erosion of the cartilages themselves does not produce any special symptoms—at least, that is the opinion of almost all surgeons of the present day¹—and the grievous starting pains which characterise the disease are produced by pressure on the inflamed bony surfaces which are exposed by their removal. Sir B. Brodie himself came to this conclusion, and has expressed in the latest edition of his work the opinion 'that the increased sensibility in these cases is in the bony plate beneath the cartilage rather than in the cartilage itself; and that the presence of severe pains with involuntary startings of the limb is always to be regarded as a sign of the bone partaking of the disease.'² If any further proof of this be wanted, it may be found in the fact that similar pains and startings often take place after excisions of the knee and elbow, when every portion of the cartilage has been removed, though they are not so severe as in joint-disease, partly, perhaps, because in excision the sensitiveness of the bone where it has been divided is less than that of the articular lamella, and partly because the muscular action is interfered with by the wound. For there can be no doubt that the spasms which produce such agony in ulceration of the cartilages are due to reflex irritation of the muscles, bringing the inflamed end of the bone into contact either with cartilage opposed to it, or, what must be far more painful, with another inflamed portion of bone.

1. The various events which we have just noticed are easily understood from a consideration of the anatomy of the disease.

When the disease subsides after the cartilages have been ulcerated and the bone only somewhat inflamed, no pus, or no considerable amount of pus, having been effused into the articulation,³ the ulcerated spot may fill up by means of fibrous tissue, and possibly no ankylosis whatever may take place; or, if a slight fibrous band, or bands, should form between the ulcerated spot and the opposite surface of the joint, it may give way. The formation of these fibrous bands is easily understood from the tendency to fibrillation observed in the articular cartilage in inflammation and the rapid development of vascular channels in it.

2. When the suppuration has been more considerable, but chronic, it will make its way to the surface, leaving, in all probability, some part of the bone exposed; and as the suppuration progresses the ligaments are inflamed and softened, so that the interarticular ligaments are apt to give way, and the capsule to yield to the pressure of the bone, now displaced by the muscular action, and so dislocation will ensue if great care is not taken.

Finally, the occurrence of acute suppuration in the joint needs no explanation, since pus is furnished not merely by the cartilage, but in far

¹ Redfern says: 'Most extensive disease may be going on in many joints at the same time, and may proceed to destroy the whole thickness of the cartilage in particular parts, without the patient's knowledge, and while he is engaged in an active occupation.' I once saw a striking ocular demonstration of the utter painlessness of ulceration of the cartilage. I had amputated at the knee-joint in a case of injury, leaving the whole of the cartilage covering the femur intact. Unluckily my anterior flap (which had been injured in the accident) sloughed, and the end of the femur covered by its cartilage lay exposed. We watched the cartilage melt away by ulceration during many days till the whole bone was denuded. The patient remained quite insensible to the process.

² 'Works,' by Charles Hawkins, vol. ii. p. 244.

³ Several interesting cases will be found recorded by Brodie, in which ankylosis apparently complete has ensued on ulceration of the cartilages, without any formation of pus. See especially the case numbered xlv. on p. 242 of the second volume of his collected 'Works,' edited by Mr. Charles Hawkins.

greater quantity by the granulations on the inflamed synovial membrane and bone.

The treatment of this acute inflammatory disease is at the present time less active than it used to be; but still, though we have, perhaps, been wise in giving up the excessive local bleeding and counter-irritation and the free administration of mercury which were in vogue some years ago, we have abundant opportunities of testing the value of more moderate antiphlogistics and counter-irritants in the form of the free application of leeches, blistering, or issues. The strictest local rest should be at the same time enforced. If the joint is too irritable to bear a splint it should be supported on all sides by some soft substance, such as a junk well padded with tow or cotton-wool sufficiently to prevent any serious displacement; or if such displacement has taken place before the case is seen, the limb should be at once put into as good a position as possible under anæsthesia. The free administration of opium to such an extent as will relieve the pain is necessary. In robust persons with high inflammation I have often seen great improvement from a course of mercury rapidly administered; and, although conscious of the evils which follow the indiscriminate use of mercury, in such cases I venture to recommend it.

The necessity for amputation arises when the symptoms of abscess in the joint are plain, and when in the surgeon's judgment the patient has not strength to survive the opening of the abscess—as to which enough has been said above (p. 474).

Excision is not successful, and should not be practised in these acute conditions of inflammation in the lower limb; but in the upper limb there is no such objection, and I have more than once excised the elbow with success in the acute stage of the disease.

There are other degenerations of the articular cartilages, as hypertrophy, atrophy, fibrous, fatty, and calcareous degeneration; but they produce no known symptoms during life, and I must therefore refer the reader to works on pathological anatomy for their elucidation. The extensive changes thus found in the cartilages, with no symptoms during life, strengthen the opinion that in the destructive disease called 'ulceration of the cartilages' the condition of the latter is really a subordinate feature.

Other
degenera-
tions of
cartilages.

Loose 'cartilages,' or, as some prefer to call them, 'loose bodies,' in the joints, are sometimes numerous. They are seen almost, but not quite, exclusively in the knee-joint. Rare cases are recorded and preserved in the elbow and other joints, but they are rather surgical curiosities than matters of practical interest. The following will therefore apply to the disease as found in the knee.

Loose
cartilages.

Many of them are not really cartilaginous—at least, if there is any true cartilage in them it is in such small quantity as to escape even a careful examination. The bulk of the body consists usually of fibrous tissue, in which perhaps a small cartilaginous nodule may be found, and the cartilage is sometimes extensively or almost entirely calcified. In other cases, however, they have been found cartilaginous throughout, and in some true bone forms a part or the whole of them, and I have seen a case in which the supposed loose cartilage turned out to be a piece of semi-solid lymph.¹

¹ Brodie ('Works,' by C. Hawkins, vol. ii. pp. 288, 289) relates two interesting cases in which the symptoms of loose cartilages were produced by 'fleshy tumours' attached to the synovial membrane, which were operated on with success. The structure of these

The causes which produce these loose bodies will throw some light on their anatomy. Hunter believed¹ that they often arise from contusions in which blood is effused into the joint; and this blood, becoming organised and then being separated from the inner surface of the synovial membrane, gives rise to the loose body. And although modern pathologists may hold different views from Hunter about the frequency of organisation of blood-clots or the manner in which it occurs, it cannot be doubted that accident is a frequent cause of loose cartilage. This accident may possibly produce extravasation into some of the fringed processes of synovial membrane, in which it is well known that minute portions of cartilage may often be found. If such extravasated fringes become subsequently thickened by inflammation, their attachment to the main portion of the synovial membrane may become gradually looser, until at length they drop completely into the cavity, and then would be found to present exactly the structure generally seen in a loose cartilage. And this explanation of their origin is also consistent with the fact that they are frequently found not perfectly loose, but pedunculated. In other cases, however, there is no doubt that they originate spontaneously from the detachment of similar fringed processes, which in some persons are found unusually large and numerous,² especially in cases of chronic rheumatic disease, where they become hypertrophied; the cartilage cells which are normally present in them forming the starting-point of a new cartilaginous growth, or the osteophytic outgrowths which form in osteo-arthritis may project into the cavity of the joint and become separated (Billroth). Finally, there are cases (though probably not very many) in which a piece of the articular cartilage, or even of the articular end of the bone, may be knocked off, and fall as a loose body into the joint.³

The symptoms which they produce are acute pain when the foreign body gets between the ends of the bones in the movements of the joint. Thus the patient in walking is suddenly seized with acute agonising pain in the joint, which causes faintness, and he probably falls. This is often followed by more or less synovitis, so that the limits of the joint are somewhat extended. The loose body is often plainly to be felt in the sac of synovial membrane which extends in front of the femur, and then may fall into the back of the joint again and perfectly disappear. The patient usually is quite conscious of its presence, and can often bring it into reach when the surgeon cannot.

In the treatment of this affection it is necessary, I think, to bear in mind that the knee-joint cannot be opened without danger, though this danger is comparatively slight since the introduction of precautions to prevent the entrance of septic materials into the cavity of the joint. Therefore, in persons whose occupations are not active, and who do not suffer much from the presence of the foreign body, it may be more prudent to temporise with the disease by fixing the loose cartilage if possible in the upper sac of the synovial cavity, where its presence is comparatively harmless. This may

tumours is not very accurately described, but one of them at least is distinctly asserted to have been traversed by vessels.

¹ Hunter's 'Works,' vol. i. p. 520, and vol. iii. p. 625.

² See the figure on p. 337, vol. ii. 'Syst. of Surg.' 3rd ed.

³ See the cases of detachment of a piece of cartilage, related by Mr. Teale, 'Med.-Chir. Trans.' vol. xxxix. p. 31; by Mr. Brodhurst, 'St. George's Hospital Reports,' vol. ii. p. 141; and of detachment of a portion of the bone along with the cartilage over it, by Mr. Simon, 'Path. Trans.' vol. xv. p. 206, by Brodie, vol. ii. p. 284; and by Nélaton, 'Path. Chir.' ii. 182. Such an accident is believed by some to be impossible. See a letter by Professor Humphry, 'Brit. Med. Journ.' vol. i. 1888, p. 613.

sometimes be accomplished by circular strips of strapping fixed above and below it, or by a bandage with a hole to receive it, and it is even possible that the loose body may at length adhere in that position. It will, of course, be understood that the movements of the joint are restrained meanwhile by a firm bandage or knee-cap. Attempts have been made to fix the loose body by driving a fine needle or silver suture through it, but not, I believe, with encouraging results. But in most cases, where the joint is otherwise healthy and the patient is obliged to use it, the removal of the loose cartilage becomes necessary; and this is effected in one of two ways. In both the body must be securely held by the surgeon's left forefinger and thumb placed under it, or if it is very loose it may be steadied by means of a needle. Then in the *direct* method of extraction the surgeon cuts down on the loose substance and gently squeezes it out of the wound, following it with his finger and thumb, so as, if possible, to prevent the escape of synovia from the joint. And in order that the wound into the joint may be less direct, it is well to have previously drawn the skin to one side over the loose cartilage, so that when the parts return to their proper position the skin-wound no longer corresponds to the opening in the joint. In the *subcutaneous* method (which is believed to be more safe, though the evidence on that point is not conclusive) a tendon-knife is passed down to the surface of the loose body, and a bed or cavity formed for it in the track of the knife; an opening is then made into the capsule of the joint, through which the cartilage can be squeezed into the subcutaneous tissue. There it is left, either for life, or, if it causes any inconvenience, until the opening in the joint has long healed, when it is cut down upon and extracted. In some cases difficulty is experienced in squeezing the body out of the joint, in consequence of its being not absolutely loose but pedunculated. An interesting instance is reported by Sir W. McCormac ('St. Thomas's Hospital Reports,' New Ser. vol. v. 1874) in which he finally succeeded by vigorous pressure with his thumbs in rupturing the pedicle and pushing the loose body out—and the same case also illustrates another point in the surgery of loose cartilage, viz. that the loose body often diminishes in size when it has been squeezed out of the joint and lodged in the cellular tissue.

These operations should always be performed after the antiseptic method, as recommended by Prof. Lister, and certainly are then attended with very remarkable success. Thus, in a case under Mr. Haward's care, where he put a lithotomy scoop into the joint in order to extract a body which was remarkably difficult to seize, and in a remarkable case which occurred to myself, where there were seven large loose cartilages, and where I put my finger and forceps freely into the joint in order to find and seize them, no bad symptoms whatever ensued. A still more remarkable case was lately alluded to by Sir J. Paget,¹ in which Mr. T. Smith removed more than two hundred loose cartilages from the knee-joint. In that case, however, as Mr. Smith informs me, suppuration ensued, and the joint became stiff.

It is essential to disturb the parts as little as possible, to unite the skin-wound or puncture immediately and very carefully with suture or strapping, to bandage the limb evenly from the toes, and to fix it securely on a well-fitting splint. The tendency to inflammation will thus be best obviated; but if the knee does inflame, cold should be at once applied; and if the inflammation increases and becomes violent, suppuration is imminent, and the case must be treated accordingly.

¹ 'Bradshawe Lecture at the College of Surgeons' in 1882, p. 7.

Chronic
rheumatic
arthritis.

Chronic rheumatic arthritis, arthritis deformans, rheumatoid arthritis, osteo-arthritis, rheumatic gout, nodosity of the joints, is a disease usually commencing in middle life, though occasionally occurring in early adult life. It is of an exceedingly intractable and disabling character, causing the patient great suffering, but having no tendency to shorten his existence; so that he may live to old age, becoming more and more crippled by the disease. It may be confined to one joint or may attack several, one after another. All joints are liable to be implicated; but the hip, the knee, the shoulder, and the temporo-maxillary articulation are especially prone to be effected. It would appear that it attacks the hip more commonly in the male, and the knee in the female.

Most pathologists are now agreed that in the majority of cases of this disease the cartilages are first affected, though the other structures of the joint, synovial membrane, bones, and ligaments speedily become secondarily involved. The cartilage cells first proliferate, and the primary capsules become enlarged and filled with secondary capsules. The matrix around them becomes softened and fibrillated, and the enlarged capsules open into one another, forming alveolar spaces. On the surface of the cartilage the capsules dissolve and set free their contents into the joint. In consequence of these changes the cartilage becomes softened and gradually worn away in the centre of the joint—that is to say, where there is greatest friction—leaving the bone exposed. At the same time the circumference of the cartilage, not being subjected to pressure, is not worn away, but, being softened by the same process going on in it, becomes pressed out, as it were, and forms an irregular nodular thickening around the articular surface. If examined in the early stage the cartilage will be found to have lost its smoothness and polish, to be of a dull yellow opaque appearance, and to be rough on its surface. As the cartilage wears away the bone becomes exposed and eburnated. It undergoes a sclerosing osteitis with excessive calcification, so that the bone becomes hard and porcellaneous in appearance, and, from the movements of the joint, smooth and polished on its surface. In spite, however, of this eburnation the bone becomes gradually worn away by friction, and the articular surfaces frequently at this period present an undulating surface—alternate ridges and furrows—owing to the peculiar manner in which the wearing away has taken place. Meanwhile further changes take place in the bones in the neighbourhood of the articular surfaces. The ends of the bones become flattened out and expanded and the neck shortened, so that in a bone like the humerus or femur the upper extremity assumes somewhat of a mushroom shape. The articular cavities become enlarged and flattened out and surrounded by osteophytic outgrowths. In the early stage of the disease the synovial membrane becomes more vascular, thickened, and swollen. The villi, or fringes, become increased in size, and branch out secondary processes, so as to give the interior of the joint an arborescent appearance. In some cases the synovial secretion is increased in quantity, and is turbid or cloudy. This is especially noticeable in the earlier stages of the disease, and frequently disappears after a time. In some cases there is scarcely any increased secretion of synovia, and the disease is essentially 'dry' throughout its course. As the disease advances the capsule of the joint becomes greatly thickened, and osteophytes spring up from the periosteum of the bones around the joint, producing greater deformity than that which already exists, and further interfering with the movements of the articulation. There is little or no tendency to suppuration, nor does anky-

losis ensue, though the limb may be stiffened from the unnatural shape of the bones. In the more favourable cases, however, just the opposite issue follows; for as the joint-surfaces become polished on each other the movement becomes again free and painless.

The chief symptoms of chronic rheumatic arthritis are pain, rigidity, deformity, and grating. The pain is of a peculiarly wearing, aching character, and is especially worse at night and in damp weather. It would appear to be probable, from this fact that the pain is worse in damp weather, that the disease has earned for itself the name of chronic *rheumatic* arthritis, for it has but little in common with rheumatism to entitle it to this name beyond this one fact. The rigidity is due to the interlocking of the additamentary bones, and in those cases where these formations do not take place to any considerable extent the movements may, as stated above, be free and painless. The deformity is due to the alteration in shape of the bony surfaces, and to the formation of the osteophytic outgrowths around the joint. The crackling or crepitus is due partly to the rubbing of the joint-surfaces on each other and partly to that of the additamentary bones. It is sometimes so loud as to be distinctly heard all over the room.

The treatment of this complaint when it is fully established—i.e. when the shape of the joint-surfaces is much altered and they are exposed and crackle on each other—is never very satisfactory. All that can then be done is to palliate the pain by opium if necessary, hot douches, regulated pressure, and support to the joint. But in the early stage treatment by rest and warm or stimulating applications, and particularly residence in genial climates, and the persevering use of hot springs, may do much to avert the occurrence of the more profound and incurable changes in the bones and ligaments.

In a very few cases excision of the affected joint has been practised. Thus Dr. Humphry excised the condyle of the jaw,¹ and the head of the femur has been excised on account of chronic rheumatic arthritis at an unusually advanced age, and with alleged success. Such operations, however, can seldom be advisable, since the disease is a constitutional one, and therefore liable to present itself anew in another joint; nor is the suffering which it occasions sufficient, as a rule, to justify so dangerous an operation.

It is now universally admitted that most of the cases which have been published as 'partial dislocations,' especially of the shoulder, and as 'fractures with ligamentous union' of processes in the neighbourhood of joints, such as the acromion, were really instances of chronic rheumatic arthritis accompanied by changes in the shape and position of the joint-surfaces, by erosion and unnatural adhesion of the tendons near the heads of the bones, and by the formation of the additamentary bones, which are characteristic of this affection.²

A very interesting form of arthritis has been described by M. Charcot,³ in which a disease very similar to, if not identical with, chronic rheumatic arthritis is developed in connection with locomotor ataxy. The views of the leading physicians and surgeons of the day on the connection between this affection of the joints and that of the nervous system are still somewhat at

Charcot's
disease.

¹ 'On the Human Skeleton,' p. 306.

² See Dr. R. Adams's work on 'Rheumatic Gout,' 2nd ed. pp. 118 et sqq.; and his plate iii. figs. 1, 2.

³ On 'Arthropathies of Cerebral or Spinal Origin,' in Charcot's 'Lectures on Diseases of the Nervous System,' translated for the New Syd. Soc.

variance.¹ Charcot and his followers believe that the degeneration of the nervous system produces trophic changes in the bones and other tissues of the joints. Others think it more probable that the connection between the affections is mainly one of coincidence, or that possibly both are produced by the same remote cause; while others teach that the loss of sensibility which is produced by the spinal affection allows of passive and active movements whereby the deformity of the bones is aggravated. Be this as it may, there is, no doubt, a form of disease which, though characterised by the same anatomical and pathological lesions as are met with in osteo-arthritis, occurs in connection with locomotor ataxy; though whether the two conditions are to be looked upon as cause and effect, or as being dependent upon some common cause, is at present undetermined. There are, however, some important differences in the physical signs of the two diseases—ataxic arthropathy, or Charcot's disease, and chronic rheumatic arthritis—which it is important to note, and which, clinically, serve to distinguish the one disease from the other, independently of the general symptoms of locomotor ataxy, which exist in the one case and not in the other.

In ataxic arthropathy the onset is sudden, and is attended with considerable effusion into the joint. In chronic rheumatic arthritis the onset is gradual, and is rarely attended with much, if any, effusion. In locomotor ataxia the formation of osteophytic outgrowths is slight; in rheumatic arthritis they are constant and considerable. In the former disease dislocation is common; in the latter, rare. The progress of the two diseases is also dissimilar. In ataxic arthropathy the progress of the disease may be arrested, and may subside either partially or entirely; whilst in arthritis deformans the disease is progressive, and often permanent. In addition to these distinctive characteristics in Charcot's disease there are the symptoms of locomotor ataxy, such as want of co-ordination, absence of patellar reflexes, 'Argyle Robertson pupil,' gastric crises, lightning pains, and other symptoms, for which I must refer the reader to works on Medicine. Treatment can be only palliative, and must be conducted on ordinary principles.

Ankylosis.

Ankylosis, or stiffening of joints, is of three kinds. In the first, which is denominated the *extra-articular*, it depends on fibrous adhesions in the soft parts external to the bones, such as take place in limbs which have been long kept in constrained positions, as in the treatment of fracture. In the second, or *fibrous* (false) ankylosis, the joint-surfaces are united by bands which pass from one articular cartilage to the other, such as have been above described as forming after ulceration of the cartilages or after synovitis. In the third, or *bony* ankylosis (synostosis), the cartilages and articular lamella having been removed, the bones, exposed and ulcerated, unite, as in compound fracture, by granulations, in which ossification occurs, until at length the whole becomes one solid mass of bone.

The diagnosis between bony and fibrous ankylosis can usually be made under chloroform; for in the fibrous ankylosis some amount of passive motion is always possible, while in the bony there is none. And again, in bony ankylosis the muscles around the joint waste to an extent which is never seen in the fibrous. The diagnosis between the fibrous and the extra-articular ankylosis can be made in part by the history and in part by the result of examination under chloroform. In fibrous ankylosis movement is

¹ See an interesting discussion, 'Clin. Soc. Trans.' vol. xviii.

fettered by a definite band or bands. It is therefore perfectly unopposed until those bands are put on the stretch, when it is abruptly checked. In the extra-articular it is a generally stiffened condition of all the parts around which opposes motion.

The treatment must be determined partly by the nature of the ankylosis, and partly by the amount of inconvenience which it causes. Extra-articular adhesions can usually be got rid of by constant passive motion, oiling the part, gradually or abruptly stretching it, or applying various extending apparatus. Many instantaneous cures are affected in this and in fibrous ankylosis by sudden wrenches which break down the bands and restore motion at once. Such cures are often worked haphazard (and, sometimes, also, it must be owned, with a definite purpose and knowledge) by quacks in cases neglected or given up by regular practitioners, much to the shame of the latter. Remembering the frequency of these cases, we should be cautious of insisting too long on confined positions of joints in the treatment of accident or disease; and when stiffening has taken place, and all inflammatory symptoms have subsided, a careful examination under chloroform will often detect one or more definite bands, which can be ruptured, and the part at once restored to its function, gradually increasing passive and active motion being afterwards carefully insisted on.

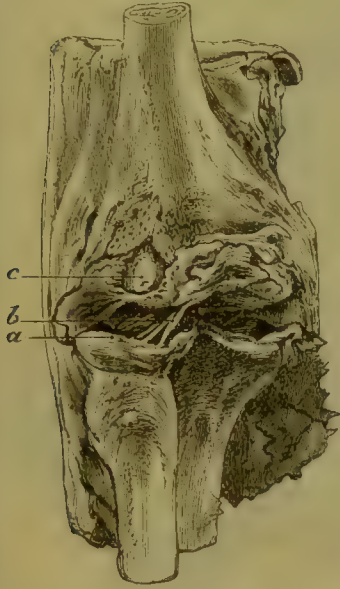


FIG. 224. Fibrous ankylosis of the elbow-joint, from a preparation in St. George's Hospital Museum, Ser. iii. No. 80. *a*. The head of the radius covered with diseased and thickened synovial membrane. *b*. Fibrous bands containing large blood-vessels (filled with injection in the preparation) binding the head of the radius to the humerus, and so abolishing its movements. *c*. A portion of the articular end of the humerus exposed and carious.

In more extensive fibrous ankylosis there will be much more difficulty in restoring mobility. Long patience is required on the surgeon's part, and unusual confidence on that of the patient, before the desired end can be reached; and often the adhesions will re-form time after time. Still, even if ultimately a stiff joint is left, at least its position may be improved and the limb be left useful instead of useless. Some caution is necessary, in making forcible extension in such cases, to avoid doing injury to neighbouring parts or fracturing the bones in childhood, or in adults when the bone is weakened by atrophy. A useful precaution is to hold the bones as near the joint as may be, and to rupture the adhesions by short movements in the way of flexion before attempting to put the limb straight by extension movements. Again, the tendons, in case of old dislocation or ankylosis in false positions, are often so contracted as to require division before the case can be successfully treated, and this must always be done some days before the attempt at extension.

Bony ankylosis is one of the methods of cure in joint-disease, and it should not, therefore, be interfered with, unless the position in which it has occurred renders the limb useless; except possibly in the elbow-joint, where the results of excision are so good that it may be considered advisable and for the welfare of the patient to excise the ankylosed joint, so as to substitute a movable for an immovable articulation.

If, however, the position of the ankylosed limb is faulty, much may be

Sub-cutaneous division of bone for ankylosis.

done by osteotomy to remedy the deformity. This operation was introduced into practice by Langenbeck and Gross¹ for the cure of angular ankylosis of the knee; but to Mr. W. Adams we owe the operation of subcutaneous division of the neck of the thigh-bone in faulty ankylosis of the hip-joint.² In Adams's operation a small incision is made with a long narrow knife, a little above the great trochanter, and is carried straight down to the neck of the femur; the knife being withdrawn, a narrow saw is introduced, and the neck of the bone sawn until it will give way and allow the limb to be put straight; or the bone is divided with a chisel or mallet. All this is to be done, like other osteotomies, with antiseptic precautions. In many cases, however, of synostosis of the hip-joint in a vicious position, Adams's operation is not applicable, there has been such shortening of the neck of the femur and so large an amount of bony thickening and deposit around (as in Fig. 225) that this operation could not be performed. In such cases the plan devised by Mr. Gant is to be preferred—viz. to divide the femur just below the small trochanter, either with the saw or chisel.

In faulty synostosis of the knee-joint—that is to say, with the bones of the leg ankylosed to the femur at more or less of an angle—it is necessary to remove a wedge-shaped piece of bone from the convexity of the articulation in order to bring the limb into an extended position.



FIG. 225. Bony ankylosis of the hip-joint, from a preparation in the Museum of St. George's Hospital, Ser. iii. No. 111a. The femur has been allowed to ankylose in position almost vertically upwards. There has been extensive disease of the head and neck of the femur, which have been replaced by a large irregular mass of bone completely fused with the exterior of the pelvis. The lesser trochanter of the femur is also fused with the anterior inferior spine of the ilium. *a* points to a foramen which exists between the principal ankylosis and this secondary formation of bone.

Hysterical
and neu-
ralgic affec-
tions.

Neuralgia and hysterical affections of joints, though they are not identical, yet are hard to separate from each other in practice. They are both characterised by pain which is out of all proportion to the evidence of actual change of structure, though there is in some cases some amount of swelling or puffiness around the joint, testifying to the presence of a certain degree of increased vascular action, which, however, is rather the consequence than the cause of the pain. In many cases this neuralgic affection is only one of the symptoms of general hysteria as testified by the other ordinary phenomena of that state; but in other cases there is no such general affection. True neuralgia is periodic, and is usually connected with some disturbance of general health or digestion. It must be treated, as in other parts, by anti-periodics, as quinine, arsenic, or hydrochlorate of ammonia in full doses, and especially by attention to the general health and the condition of the bowels, and by free exercise of the part.

The distinction between hysterical affection of a joint and organic disease

¹ See 'New. Syd. Soc.'s Retrospect,' 1867-68, p. 256.

² Adams on 'Subcutaneous Division of the Neck of the Thigh-Bone,' London, 1871.

is made chiefly by noticing the disproportion between the pain and the evidence of local lesions,¹ by the varying and inconsistent nature of the symptoms, and by examination under chloroform, which is often perfectly decisive, as it is also in voluntary imposition. It is strange in these cases to see how motion, which has seemed almost impossible while the patient was conscious, becomes at once completely natural when anæsthesia is obtained, and the perfectly smooth and natural condition of the articular surfaces testifies to the absence of all serious disease.

The diagnosis is, however, most difficult in practice, though its principles when stated in the above summary manner appear to be easy. A careful perusal of Sir J. Paget's lectures on this topic will show that there is no symptom of organic disease of a joint which may not be imitated by 'nervous mimicry,' as he calls it—the lameness, the permanent loss of use, complete stiffness, wearing pain, even wasting of the muscles around the joint:² and the matter becomes still further complicated when we reflect that on the one hand a patient most obviously hysterical may, nevertheless, have articular disease, and that on the other a patient may be suffering from nervous disease who displays no trace whatever of hysteria. Hence Sir J. Paget dwells forcibly on the necessity of commencing the investigation of the case with the local symptoms and appearances, and giving to the latter far greater weight in diagnosis than to the general aspect and history of the patient. But it is wise not to be in a hurry, and only to form and announce a positive opinion after careful and repeated examination and observation.

The treatment of these affections is spoken of on p. 391.

The above observations on the general pathology of joint-diseases are intended to be applicable to all joints in the body, though they are chiefly drawn from the phenomena of the diseases of the knee. We must now speak more particularly, though very shortly, of the diseases of some of the other joints.

The disease of the hip (*Morbus Coxarius*), which is so common in the poor weakly children of our large cities, and which is seen occasionally also in children who are more fortunately circumstanced, is by some regarded as the result merely of local injury which has been neglected, and which is unassociated with any constitutional taint; whilst by others it is looked upon as being essentially a strumous disease. There can be no question that cases of hip-joint do occur, as the result of injury, in patients who are otherwise healthy; which are susceptible of complete cure, without any constitutional affection being left behind, or any tendency to disease in any other part of the body; but nevertheless, I believe the disease occurs most commonly in strumous subjects, and that it then owes its progressive tendency to the strumous diathesis.

Disease of
the hip.

¹ Sir J. Paget dwells especially on the importance of the local temperature. In inflammatory affections, as synovitis, the heat of the joint is perceptibly increased, as felt by the hand laid over it; and this is not the case in nervous disorders. This test, however, is only applicable to the superficial joints.—Paget's 'Clinical Lectures,' p. 215.

² Not, however, the acute atrophy of serious disease. Mr. Barker remarks on this head 'that rapid loss of tissue observed about a joint truly diseased is never seen here. Disease (if the other limb be still used) may produce leanness on the painful side, as compared with the opposite; prolonged and firm bandaging may do the same, or the wearing of elastic coverings: but the loss of bulk is usually trifling, and in clear contrast to what might be expected were disease present in a degree equal to the patient's belief, or in correspondence to other symptoms.—'Syst. of Surg.' 3rd ed. vol. ii. p. 363.

The pathological anatomy of the early stage of hip-disease is not easy to determine, and is the subject of considerable difference of opinion; but it appears to me probable that the disease commences at one time in the bones which form the hip-joint—either the head or neck of the femur or the acetabulum—and at another in the synovial membrane. The view formerly entertained, that the disease commences in the ligamentum teres or the capsular ligament, appears to be very generally abandoned. It seems to me that the most rational way of regarding the affection is to look upon it as a strumous arthritis, at all events in the majority of cases, beginning, like the same condition in any other joint, either in the synovial membrane or the bone, and subsequently involving all the other structures of the articulation. The symptoms of disease of the hip are generally divided into three stages: 1. The first, or inflammatory stage, is characterised by pain, limping, alteration in the position of the limb, impaired mobility of the joint, swelling and wasting of the muscles. The pain varies very much: in some cases acute pain in the hip may be the first symptom which will draw attention to the disease; in other cases it is very slight. Frequently it is referred to the knee-joint, to the part supplied by the terminal fibres of the obturator nerve, which supplies both articulations. It is always increased by over-use of the joint, so that the child will frequently complain of pain after a walk or after playing for some time, which will pass off upon resting. The limping or lameness is an early and constant sign; and frequently the mother's attention is first called to her child's condition by noticing it limping as it walks. Too often, however, no attention is paid to this symptom; the child is believed to have acquired a bad habit, possibly is corrected again and again; but the matter is not regarded as one of any consequence and no advice is sought. The alteration in the position of the limb is also an early symptom. If a child suffering from early disease of the hip is stripped and laid in the supine position on a hard couch, it will be at once noticed that the foot of the affected limb projects beyond its fellow, and the whole leg will thus appear to be lengthened. Upon measurement, however, the limbs will be found to be the same length, and that the lengthening of the extremity is *apparent* and not real. If now the forefingers are placed on the anterior superior spinous processes of the ilia, it will be found that the one on the affected side is on a lower level than the one on the sound side, and that a straight line drawn between the two is not horizontal but oblique. The apparent lengthening of the limb is therefore due to obliquity of the pelvis. If now the limb be moved away from its fellow—that is to say, abducted—the anterior superior spinous process will be seen to ascend until with a certain degree of abduction it has reached the same level as the one of the opposite side. It is clear, therefore, that the natural position of the limb has been altered, and the thigh is now abducted, and that therefore the child, in order to produce parallelism of the two extremities, lowers the pelvis on the affected side, and so produces the apparent lengthening of the limb. Again, while the child is still lying supine on the hard couch, if the hand be placed under the back, it will be found that there is a convexity forwards of the spine in the lumbo-sacral region, so that the vertebral column forms an arch in this situation (lordosis). If now the affected limb be raised from the bed this arch gradually disappears, until, when the limb has been raised to a certain height, it is entirely gone. From this it is argued that the normal position of the thigh in an antero-posterior direction is altered, and, instead of being in a straight line with the trunk, is flexed to a certain extent upon it. In order to bring the foot to

the ground the child is therefore obliged to rotate the whole pelvis forwards upon a horizontal axis drawn through its centre, and thus produces an anterior curve in the lower part of the spine to compensate for this rotation. Finally, the whole of the affected limb will be seen to be rotated outwards; the patella will be found to lie somewhat external to its proper position on the front of the knee-joint, and the outer side of the foot to be inclined towards the couch. The position of the limb, therefore, in the first stage of hip-joint disease is one of abduction, flexion, and external rotation. The cause of this position is the subject of much difference of opinion. Mr. E. Owen¹ attributes the abduction and flexion of the limb in a great measure to the distension of the capsule with fluid; the effect of which he shows by an ingenious experiment on the dead subject. The same view is adopted by Mr. Barker.² But the difficulty in believing that the position of the limb in hip-disease is due solely to the distension of the capsule lies in the fact that in very many cases there is no trace of any such distension. Others, again, believe that the position of the limb is due to reflex contraction of certain muscles. The most probable explanation, however, is that the position is the one of greatest ease and the one in which all the ligaments of the joint are most relaxed, and is therefore unconsciously assumed by the patient. Impaired mobility of the joint is perhaps the most important and the most valuable sign of hip-joint disease, and is that which is most convincing. In a large percentage of cases which come under the notice of the surgeon, this impairment of motion is so advanced that there is absolute fixation of the joint, so that the child, if requested to raise its limb from the bed, will move the whole pelvis, and the anterior superior spinous process of the ilium will be found to recede from the finger placed upon it, and no movement in the hip-joint to take place. But even in more recent cases than this, the contrast between the easy and even movement of the healthy joint and the stiff, painful, imperfect motion of the diseased articulation is very striking. There is occasionally some fulness in front of the hip, as if from effusion into the capsule of the joint. This will best be perceived by noting the partial or complete obliteration of the fold of the groin as compared with the other side, and by the greater prominence of the inguinal glands, which may be seen to stand out under the skin, and in some cases are enlarged. Wasting of the muscles is another and important sign. It shows itself especially in the gluteal muscles, causing a characteristic flattening of the buttock and a loss of the gluteal fold at the back of the thigh. The other muscles of the limb are also wasted, and this shrinking may be apparent at a very early stage of the disease, and may be even well marked in a few weeks after its advent.

2. The second stage is that of *abscess*, which is not, however, necessarily connected with disease of the bones, nor always situated in the cavity of the joint. Very frequently it is external to the articulation, and the bones are unaffected. Examination under chloroform will settle this point by revealing true crepitus when the bones are diseased, or the grating sensation of roughened cartilage when the mischief is less deep-seated.

Stage of
abscess.

3. The third stage is that of real *shortening*.³ This shortening is pro-

¹ 'Brit. Med. Journ.,' Dec. 14, 1878, p. 873.

² 'Syst. of Surgery,' 3rd. ed. vol. ii. p. 364.

³ Other writers, following Ford, make a different classification, viz. first stage, pain, &c.; second stage, apparent lengthening; third stage, shortening. It is extremely difficult to make any division into stages which is not open to many objections and liable to frequent exceptions. The one in the text seems to me more practical and more natural

Stage of
real short-
ening.

duced by caries and absorption of the head and neck of the femur and of the acetabulum. The upper end of the femur is in some cases so disintegrated that only a small irregular projection may remain above the trochanter, and in most cases the head is found to be diminished in size, and nearer the trochanter than natural. The acetabulum is often greatly enlarged, and not unfrequently perforated by ulceration. There is abscess, which has generally burst externally, either in the thigh, the pelvis, or both. In consequence of this change of shape of the bones there is a displacement, commonly called dislocation, but which differs from dislocation in the very important particular that the ulcerated articular surfaces are not separated from each other, but remain in mutual contact, and therefore irritate each other. To this rule there are, of course, exceptions, in which the head of the femur has entirely quitted the acetabulum; but, as far as I have seen, they are very rare. In some still rarer cases, the capsule is so stretched and the ligaments have so far



FIG. 226. Dislocation of the hip from disease. A preparation, Ser. iii. No. 86, in the Museum of St. George's Hospital.—'Syst. of Surg.' 3rd ed. vol. ii. p. 372.

yielded that the head of the bone will quit the acetabulum and return again into it on manipulation with perfect ease. I have referred to such a case in my work on the 'Surgical Diseases of Childhood' (p. 438), in which the patient had not suffered from any congenital affection, where there had been no formation of matter and there was no grating of the bones on each other. But by very slight manipulation the head of the femur could be dislocated on to the dorsum ilii, as proved by the sensation of the head slipping out of the socket, which could be plainly perceived; and the characteristic shortening of the limb was then immediately produced, and the bone could be felt on the dorsum ilii. It was equally easy to reduce the bone into its natural position. So-called dislocation from disease can always be diagnosed by measuring the length of the limb, and observing the position of the trochanter, which is elevated above the natural level. The readiest way of ascertaining this is by what is called 'Nélaton's test.' If a string is stretched from the anterior superior spinous process to the tuberosity of the ischium on the sound side, it will be seen that the trochanter is entirely below it, or possibly the upper border of the trochanter just touches the string. On the affected side the trochanter rises above this line to an extent proportioned to the destruction of the neck of the femur. Or, if the surgeon prefers it, he may use Mr. Bryant's or Mr. Morris's method of measurement (see p. 290).

Nélaton's
test.

Diagnosis.

The diagnosis of hip-joint disease is not always easy; at least many mistakes are committed. Excluding hysterical or neuralgic affection, the diagnosis of which from organic disease must rest on the same principles in than Ford's, as it fixes the surgeon's mind on two of the most important events in the disease, suppuration and real shortening.

this as in other joints, the affections usually confounded with morbus coxarius are congenital dislocation, disease of the knee, psoas abscess, caries of the pelvis, disease of the bursa beneath the psoas muscle, and infantile paralysis affecting the muscles of the buttock. The best test is the loss of motion in the affected limb. For in every one of the affections above enumerated the suspected limb can be moved easily and painlessly. This is the case even in those which are accompanied by inflammation, if care be taken to relax and steady the parts which are inflamed. But some special diagnostic symptoms must be added. In congenital dislocation there is limping, possibly wasting of the muscles, and when the child stands on the limb there is shortening. But he moves quite readily and actively, though with an awkward waddle; the length of the limb can generally be restored by traction, and there is no pain on passive motion. In disease of the knee there is pain in the knee, as there is also in disease of the hip; but careful examination will show the thickening and increased heat of the parts forming the knee-joint, the stiffness on attempts at passive motion, and the other symptoms of disease of the knee. I may just remark in passing that disease of the knee and hip may co-exist, so that the proof of disease of the knee is no actual disproof of hip-disease. In psoas abscess, or in abscess of the iliac fossa or buttock from disease of the pelvis, there are the characteristic symptoms of disease of the spine or pelvis superadded to the freedom of motion of the hip. In some cases abscess in the iliac fossa unconnected with disease of the bones (as from perityphlitis)¹ has been confounded with disease of the hip, from the lameness and flexion of the limb caused by the formation of the abscess. But the special symptoms of hip-disease are absent, and a careful examination will easily detect the difference. Disease of the bursa of the psoas is a rare affection. It may be known by the pain which is produced in the tumour on extending the muscle, and the relief of symptoms and freedom of movement on its relaxation, and by the presence of a resisting and elastic, if not fluctuating tumour, of perfectly defined shape and size, in the immediate neighbourhood of the hip. Passive motion of the joint is free and painless, except when it causes pressure on this tumour. Infantile paralysis, when confined to the muscles around the hip (which is rare), sometimes gives rise to mistake on a careless examination; but the painful symptoms of hip-disease are absent, and there is no obstacle to passive motion, while active motion, if any power is left, though limited, is painless.

Congenital
dislocation.

Enlarged
bursa of
psoas.

Infantile
paralysis.

Treatment.

The treatment in the earlier stages of hip-disease consists mainly in rest and attention to the general health. If the limb has been drawn into an unnatural position it must be put straight under chloroform, which is always perfectly easy in the early stages, and extension must be applied either by a long splint or by a weight suspended from a pulley at the foot of the bed,² which is far better in children, since the long splint irritates them and is constantly displaced. The weight must be proportioned to the age of the child—3–4 lbs. for a young child, and 7–10 lbs. for one approaching puberty, may be taken as a rough average; but this must be ascertained by experiment.³

¹ See Gibney on 'Perityphlitis in Children,' 'Am. Journ. Med. Sci.' Jan. 1881.

² A diagram of extension by means of the weight will be found on page 299.

³ I do not see any object in using more force than is necessary to prevent pain and ensure the complete repose of the parts. American surgeons use very much greater extension than that suggested in the text. In a case published by Dr. Taylor of New York, in a child aged thirteen, besides an extending apparatus calculated to exercise a traction equal to 100 lbs., a weight of 50 lbs. was applied to the foot.—See 'London Med. Record,' July 1875.

Its traction seems to prevent the mutual contact of the inflamed surfaces, and the consequent muscular spasms which are so painful a feature of the disease. Mr. Marsh has recently suggested another way of using weight-extension, so as gradually to restore the limb to its proper position, and avoid the danger which he believes to be incident to forcible replacement of the parts under anæsthesia. He directs that the knee shall be gently straightened, and then that the affected limb shall be brought into such a position as entirely to correct all curvature or inclination of the lumbar spine. The affected hip being thus put into its real position (as contradistinguished from the apparent position—the one which the child assumes in order to stand or limp), which is usually one of flexion and abduction, the weight and pulley are to be applied in the line of the limb, which is to be supported on a frame for the purpose, and the pulley elevated to any height necessary; or the weight in cases of adduction may be applied at several points of the limbs by pulleys hanging over the side of the bed. Diagrams of various methods of so applying extension will be found in Mr. Marsh's lectures, 'Brit. Med. Journ.' July 28, 1877. As the muscular irritation subsides, the direction of the extension is insensibly altered till the limb is put straight. In cases where the inflammatory symptoms are unusually severe, leeches may be applied in the groin, and where there is much pain blisters or the light application of the actual cautery in the neighbourhood of the joint are often of service. But prolonged rest in bed is the main agent in the cure of the disease; and this confinement to bed, far from being deleterious, is generally attended with considerable improvement in the general health. In summer weather, if the patient's circumstances admit of it, his bed should be placed on a wheeled couch without disturbing him, and he should enjoy the fresh air; but so long as there is any tenderness of the parts on motion no disturbance of the hip should be permitted. How long that may be it is very hard to say. I have known cases treated early recover after less than half a year's rest, while more obstinate cases will require several years; but when taken in the earliest stage of the complaint hip-disease is often curable most completely, with no loss of motion, no change of shape of the parts, and no defect of health; and this forms a powerful motive for recognising the earliest symptoms of the affection. Those symptoms are often very insidious; there is little or no tangible pain, the child is often believed to suffer only from 'growing pains,' and the limping may not be constantly noticed; but the stiffness of the joint on passive motion, and the pain which is produced by attempts to move the thigh, especially in the sense of abduction,¹ are symptoms which careful examination can hardly fail to verify at any period at which the disease can be diagnosed.

Splints for
constant
extension

American surgeons profess to treat cases of hip-disease from the first, or after a very brief period, without confinement to bed, the limb being put up in a splint, which makes constant extension by means of a screw and ratchet while the child moves about.² The only apparatus of this sort of which I have had any experience is Sayre's, and I cannot say that the experience has been satisfactory. Though when first applied it seems to answer well, yet after a short time it gets displaced and allows passive and active movement of the joint; and I have sometimes thought that the progress of the disease was

¹ Holmes's 'Surg. Dis. of Childhood,' 2nd ed. p. 441.

² Sayre, 'Lectures on Orthopædic Surgery;' Taylor, 'On the Treatment of Diseases of the Hip-joint.'

distinctly traceable to its use. Many other surgeons speak in the same terms of this treatment.

When the patient is able to leave his bed, the splint invented by Mr. Thomas, of Liverpool, has been found very useful; and I am told by Mr. Marsh that the employment of this splint at the Hospital for Hip-disease has materially shortened the average period of confinement to bed. Mr. Marsh thus

Thomas's
splint.

Marsh's
description
of this
splint.



FIG. 227.

describes and figures it. 'The object is to keep the joint completely fixed while the patient is allowed to walk about on crutches and with a patten on the opposite foot to raise him slightly off the ground. It consists of a flat piece of malleable iron, 1 inch by $\frac{1}{4}$ of an inch for adults, and $\frac{3}{4}$ of an inch by $\frac{3}{16}$ of an inch for children, and long enough to reach from the lower angle of the shoulder-blade, in a perpendicular line downwards, over the lumbar region and the pelvis, slightly external to the posterior superior spinous process of the ilium, over the prominence of the hip, and along the course of the sciatic nerve to a point slightly internal to the centre of the extremity of the calf of the leg. The iron must be modelled to this tract to avoid excoriations. This iron forms the upright portion. The upper cross-piece, which buckles round the chest, is made of hoop-iron firmly riveted to the upright. It is moulded of an oval form, to prevent rotation of the splint and inversion of the limb. Two other pieces of hoop-iron are

fastened to the upright—one at its lower end, and the other a little below the fold of the buttock. This splint when padded and adjusted to the limb (see Fig. 228) maintains the joint at perfect rest. Should deformity be present, the splint is adapted to the distortion, and then is very gradually straightened as the parts yield, and in this manner the limb is brought into its natural position. A wooden clog like those worn by draymen (Fig. 227) is more convenient for raising the opposite limb than the patten shown in Fig. 228. Although I am convinced that distortion may be best removed by means of the weight, I have no doubt Mr. Thomas's splint is also useful to correct it. I have often used it with the best results for fixing the joint in cases in which movement produced severe pain. It enables us to move patients safely from room to room, even when the disease is still acute. It is very efficient in preventing recurrence of flexion. It is much superior to the various



FIG. 228.

shield-splints, whether of leather, gutta-percha, plaster of Paris, &c., which have been moulded on the hip to 'protect the joint.' These are not nearly so useful, since by stopping short of the thorax they do not so effectually fix the articulation. During convalescence or in subacute cases, patients get about very well on crutches with the splint and the patten; but remember there is some danger that they may accidentally fall, or may take too rough exercise; and therefore let them be always carefully watched. Remember,

too, that the splint is not so appropriate when the patient is to lie long in bed. The close confinement to the horizontal posture which it enforces would grow extremely irksome; the weight treatment is better for such cases. Lastly, notice that, while wearing the instrument, the child should have a soft bed. On a firm mattress, the splint thrown out into relief would lead to painful pressure.'

Dr. J. C. Hutchinson of New York¹ recommends the elevated clog on the sound side with crutches but without any other apparatus, believing that the weight of the limb will produce sufficient extension and the muscles will instinctively retain the part at rest; and when there is no malposition and little if any pain this plan seems to me sufficient.

Treatment
of abscess.

Considerable difference of opinion exists among surgeons as to the advisability of opening abscesses connected with diseased hip at an early period or not. There can be no question that occasionally unmistakable abscesses disappear; that is to say, the more watery parts of the pus are absorbed, leaving behind them a residuum, in which, however, I have more than once seen fresh mischief lighted up after the supposed cure of the disease, and, in one case at all events, leading to a fatal termination. But this sequel must be regarded as the exception rather than the rule; and when once an abscess has formed it tends to increase and eventually reach the surface and burst; and, moreover, it has a tendency to burrow in various directions, and thus infiltrate the tissues around the joint. Now that these abscesses can be opened without any fear of septic infection, I am a strong advocate for opening them *early*, as I believe by this means the period of suppuration is greatly curtailed. The plan which I usually adopt is as follows. With all antiseptic precautions, I first make an incision into the abscess sufficiently large to allow of the introduction of the finger; with this I explore the cavity of the abscess, so as to assure myself that it communicates with the joint. When I have satisfied myself of this, I make an incision into the posterior part of the articulation from the buttock through the great gluteal muscle, so as to ensure direct drainage in the most dependent position. I then syringe away with some antiseptic solution the whole of the pus contained in the joint and in the cavity of the abscess, and insert drainage tubes in the two openings. I thus treat the case as we usually treat abscess in any other joint, by a direct incision in the most dependent position, so as to ensure the evacuation of pus as soon as it is formed, instead of allowing it to find its way to the surface by the circuitous course which it usually does. By this means also the interior of the joint can be daily syringed out with some antiseptic solution and all inflammatory products at once washed away. This practice, which was first advocated by Annandale in acute cases where the matter was still confined within the capsule, is also applicable and advantageous in the more chronic cases where the suppuration is not recognised until the pus is extra-articular. By it the joint can be thoroughly explored and the exact condition of the parts ascertained. If any sequestra are present they can be removed, and if the head of the bone is extensively carious, it can, in accordance with the teaching of Annandale and Croft, be taken away by sawing through the neck of the bone; though in the majority of cases this is not necessary, and a better result and a more serviceable limb is often obtained by simply early evacuating the pus from the joint and freely draining it. When the disease in the joint comes to an end, which is much sooner if treated in this

¹ 'Am. Journ. Med. Sci.' Jan. 1879.

way, by direct drainage, reparative action is set up, suppuration becomes less and less, and finally ceases, and the wound rapidly heals.

In the third stage, when the bones are obviously diseased, the question of excision becomes a practical one. The answer to this question will depend mainly on the prospect that we believe the patient to have of spontaneous cure; and this again depends on the means he has for procuring long-continued rest, with careful nursing. If this can be had, more patients, I believe, will get well than after excision, and with better limbs; but in the poor children whom we are often called upon to treat, it may be more judicious to remove the parts; and if this is to be done with any prospect of success it should not be delayed too long. The operation is not a very severe one, and it leaves a very useful limb; though I think generally the shortening is greater and the union not so firm and strong as after natural ankylosis.¹ For the details of the operation I must refer the reader to the chapter on OPERATIVE SURGERY.

Excision.

In some cases of disease of the hip, it seems justifiable to amputate at the hip-joint, either primarily or after the failure of excision. The cases in which hitherto I have seen this done are—1. Those in which the femur is so extensively affected as to render it impossible to excise. 2. Those in which after excision the wound will not heal, or the limb is left useless. 3. When osteo-myelitis attacks the femur, and the operation is needed in order to preserve the patient's life.²

Amputation in hip-disease.

The hip is also the seat of many other diseases. The ordinary so-called 'strumous' disease is one of the common affections of childhood; yet an identical affection is not by any means unknown in later life; and it is curious, but, I believe, true, that the disease in the adult is less severe and dangerous to life than in the child. I have often noticed this with surprise, and recently saw the observation confirmed in a paper by Dr. Taylor of New York. Then we meet comparatively often with affections of the great trochanter or its neighbourhood, sometimes with, sometimes without, suppuration, which it is difficult to separate from hip-disease, and which may, in fact, spread to the hip. These are usually the consequences of falls or blows, and they demand careful but decisive treatment, in order, if possible, to avert the implication of the joint. Rest and counter-irritation before suppuration sets in, and free incision, exposure of the carious or necrosed bone, the removal of sequestra, and the application of sulphuric acid to the softened bone, are the chief indications.

Other affections of the hip.

Chronic rheumatic arthritis has its favourite seat in the hip, so much so that the disease was for a long time only known in that joint, and called

¹ On this subject see a Clinical Lecture on some cases of cure after excision of the hip in 'Med. Times and Gaz.' November 3, 1877. See also, on this point and on the general questions of the indications for excision of the hip, the Report of a Committee of the Clinical Society, 'Clin. Trans.' vol. xiv. And also a very admirable paper by Dr. Yale ('New York Medical Journal,' Nov. 28, 1885), in which he impartially discusses the question of excision in hip-joint disease, and arrives at the following conclusion:—'That excision of the hip is indicated as a life-saving operation only, and that, as it has not been shown that it can save from any dangers except those consequent upon prolonged suppuration, it is, with rare exceptions, only indicated when the suppurative process has evidently reached a dangerous point and cannot be interrupted by any less serious operation.'

² For cases illustrating these three classes, see 'St. George's Hospital Reports,' vol. i. p. 147; Holmes's 'Surgical Treatment of Children's Diseases,' 2nd ed. p. 401; 'British Medical Journal,' Jan. 22, 1876, p. 116; Marshall, 'Clin. Soc. Trans.' vol. xviii. p. 234; Hutchinson, 'Ibid.' p. 340.

malum coxæ senile. The change of shape in the parts producing shortening of the limb, the wearing pain, the slow course of the disease, the crackling on passive motion, plainly mark the nature of the affection. The treatment is usually unsatisfactory (see p. 489).

Congenital
dislocation
of the hip.

A few words ought perhaps to be added on the subject of congenital dislocation which occurs, in rare instances, in most of the joints of the extremities, but especially in the hip. It is more common in the female than in the male sex, and it more often occurs on both sides than on one; it appears to be in some cases hereditary, but is not usually so. Very considerable difference of opinion exists as to its causation, but in the majority of cases it would appear to be due to arrest of development or faults of formation. Violence during parturition, the position of the fœtus in utero, *morbus coxæ in utero*, external violence affecting the fœtus in utero, have all been assigned as causes, but are unsupported by evidence. There are no symptoms to draw the attention of the accoucheur to the condition at birth, and it is often not noticed until the child begins to walk, when the peculiar gait attracts attention. It is then found on examination that there is shortening, that the trochanter is situated above its normal position, as indicated by Bryant's ilio-femoral or Nélaton's line, and that there is free mobility of the hip-joint without pain. Sometimes, but not always, the head of the bone can be felt on the dorsum of the ilium.

As age advances the consecutive deformities which invariably result are sufficiently well marked. When both hips are affected there is considerable lordosis, and the patient walks with a peculiar gait (Fig. 226). As Mr. Brodhurst says, 'the gait, in double dislocations, is most peculiar and unmistakable; no other motion is like that which is occasioned by this lesion; it is a rolling motion of the trunk, together with double lameness, and yet it is painless and rapid.' When one hip-joint only is affected, tilting of the



FIG. 229. Congenital dislocation of the hip. From a typical case in which both hips were dislocated, showing the symptoms characteristic of this affection, viz. obliquity of the pelvis, causing lordosis, disproportionate length of the lower limbs, the shoulders thrown back, the legs weak and flaccid, the feet flat. The trochanters are prominent and nearer the spine of the ilium than natural, and the head of the thigh-bone, if of the natural size and shape, can be felt on the dorsum ilii.—From 'Syst. of Surg.' 3rd ed. vol. iii. p. 800.

pelvis and lateral curvature of the spine from inequality of the length of the legs results. The results of treatment have not been, on the whole, very satisfactory. Apparatus have been worn, but in most cases the child walks better without than with them, and they only make matters worse. The chief obstacle to permanent replacement of the parts is the ill-developed condition both of the acetabulum and of the head of the femur. The head of the femur has been excised and an attempt made to scoop out a new cavity on the ilium to receive the decapitated shaft; but the operation does not seem to me justifiable. The only treatment which seems worthy of trial is that advocated by M. Pravaz, jun.,¹ and of which Dr. Buckminster Brown has published a very interesting and successful example,² viz. to draw down the femur into its natural position by protracted extension, and then fix it by a combination of extension and pressure, whereby, as it is hoped, a new depression may be formed on the ilium, and the femur may contract adhesions to the pelvis, so as to obviate renewed displacement. The treatment requires very protracted confinement and much mechanical ingenuity on the part of the surgeon. The treatment by strict rest and unremitted extension lasted in Dr. Brown's case over thirteen months. Ultimately, however, the patient seems to have been restored to the power of normal progression.

Closely connected with disease of the hip is disease of the pelvis. In fact, we have seen that some amount of disease of the pelvis almost always accompanies the last stages of hip-joint disease. But the most characteristic affection of the pelvis is that which occurs at or near its junction with the spinal column. In many cases which are diagnosed as sacro-iliac disease it is probable that the disease affects the bones of the pelvis or spine as much or more than the sacro-iliac joint itself; but when the disease is localised in the articulation its characteristic sign will be pain in sitting, standing, or walking; in fact, in any action which brings the weight of the body to bear on the pelvis. On examination it will be found that there is no pain when the hip is moved, or when the spine is flexed or extended, provided the pelvis is kept steady; but there is pain when the pelvis is moved on the spine. There is also swelling or some puffiness about the part, with increased heat to the hand or to the thermometer, pain running along the course of the lumbar nerves, and sometimes flexion of the hip from irritation of the psoas muscle. These latter symptoms may cause a suspicion of disease of the hip or spine, but careful examination will show that the movements of these parts are free and their temperature is not elevated, while the heat and pain about the sacro-iliac joint will point to the real seat of the mischief. The prognosis depends on the age of the patient, and on the stage which the disease has attained when the treatment has commenced. When the patient is an adult and the disease has proceeded to suppuration, the prognosis is generally unfavourable; though instances of recovery are not wanting. It must be treated, like disease of the spine, by complete rest, with proper attention to diet and regimen, so that the patient may be supported through the stage of exhaustion or hectic which may possibly supervene until ankylosis is obtained. As in disease of the spine and hip, it seems better to allow abscesses to open spontaneously, unless they are causing irritation.

Sacro-iliac
disease.

The diseases of the knee having been taken as typical of those of the joints generally, no further remarks need be made on them here.

¹ 'New Syd. Soc. Biennial Retrospect: 1865-66,' p. 274.

² 'Boston Med. and Surg. Journ.' June 4, 1895.

Disease of
the ankle
and tarsus.

Disease
limited to
the ankle.

Disease
limited to
the astrag-
alus.

Disease of
the astrag-
alo-calca-
nean joint.

Disease of
the os
calcis.

The ankle is, perhaps, next to the knee and hip, the most frequent seat of disease, and it is also very commonly implicated in inflammation of the tarsus. It is therefore very important to study carefully the diagnostic signs between disease limited to the ankle-joint, disease limited to the astragalus, the os calcis, or the joints between these two bones, general disease of the tarsus, and disease implicating the ankle and tarsus simultaneously. Disease when limited to the ankle-joint is marked by effusion into that cavity, which raises up the extensor tendons and produces fluctuation on either side of them, and as it increases presents at one or other or both borders of the tendo Achillis. The movements of the foot on the leg are painful, and if the disease has proceeded to denudation of the bones crepitus may be felt under anæsthesia, or there may be sinuses from which the probe can feel bare bone in the joint. At the same time there is no increase of heat, no swelling or tenderness over any part of the os calcis, except possibly just the upper part, where it is overlapped by the articular effusion; nor over the front of the astragalus. Disease which is limited to the astragalus produces swelling, heat, and tenderness corresponding to the position of the inflamed bone, and, therefore, very close to the ankle-joint, but unaccompanied by the effusion beneath the extensor tendons, or the pain on passive motion. Still it must be allowed that the diagnosis is a difficult one, and that the cases in which the disease commencing in the astragalus does not implicate the ankle are exceptional. Such cases are, however, met with; and it has occurred to me several times to remove the whole astragalus for extensive disease of the bone, leaving a healthy ankle-joint, and with complete success. Disease of the tarsus has very commonly its starting-point in the joints between the astragalus and os calcis, as Sir B. Brodie long ago pointed out, though it ordinarily begins in the structure of the bone. When the astragalo-calcanean joint is the seat of the affection there will be pain, tenderness, swelling, and heat about the upper part of the os calcis, and the movement of the calcaneum on the astragalus will be painful, though that of the foot on the leg is not. Careful manipulation is, however, necessary to discriminate this. I had recently a case under my care in which the joint was so entirely destroyed and the bones so universally carious that movement elicited such loud crepitation as to be mistaken for disease of the ankle itself. In this case the painlessness of flexion and extension of the foot ought to have obviated the error. Rest and counter-irritation before the formation of matter, and early incision with continued rest afterwards, are the essentials of treatment. The patient need not, however, be confined to bed after the abscess is opened. The foot should be put up in a plaster-of-Paris splint, with a hole cut for the opening, and he should go about, resting the knee on a wooden leg. In inveterate cases, where the bone is exposed, and the disease threatens to spread, the foot may often be preserved by excising the os calcis and removing any part of the astragalus which is diseased. Other surgeons have removed the astragalus or excised the ankle-joint including the astragalus, and then gouged away the carious portion of the calcaneum. Latterly Mr. Annandale has proposed and practised a formal operation for the resection of the affected joint itself, which will be found described in the chapter on EXCISIONS OF BONES AND JOINTS. Disease of the calcaneum is easily known by the presence of swelling limited to the bone, or of sinuses, all of which lead towards or to it, and by the absence of all the special symptoms above enumerated as characteristic of disease of the ankle, astragalus, and astragalo-calcanean joints.

The presence of general disease of the tarsus is usually indicated by extensive swelling of the whole of the foot and by pain in all its movements; indeed, all use of the foot is soon lost. And in all cases of disease of these parts the foot should be carefully examined under anæsthesia before any serious operation is contemplated, in order to ascertain whether or no these various affections are combined, as they so commonly are. It would, of course, be a serious error to excise the ankle-joint or resect the os calcis if the tarsal bones left behind were in a state of chronic softening in the one case, or the ankle-joint diseased in the other. This is an error which is, perhaps, not often committed; but it is, on the other hand, exceedingly common to see a foot amputated for supposed 'strumous disease of the tarsus,' when on examination the affection turns out to be limited to one of the tarsal bones, and the patient might have been cured by a less extensive mutilation.

General
disease of
tarsus.

Diseases of the joints of the upper extremity are as a general rule more curable than those of the lower. Besides the generally less serious character of all affections of the upper limb as compared with those of the lower there is the powerful consideration that the joints of the upper limb have not to bear the weight of the body, and can be easily kept at rest while the patient is moving about and getting air and exercise.

Disease of the sterno-clavicular joint is rare, and, as far as I have seen, occurs generally in persons of bad constitution, and is to that extent to be looked on with suspicion, though recovery not unfrequently takes place, even after extensive abscess and destruction of the joint. Rest, the prompt removal of sequestra, and the sulphuric acid treatment to any exposed bony surfaces, are the general indications.

Of the
sterno-
clavicular
joint.

The shoulder is far less frequently diseased than any of the other large joints, notwithstanding its constant movement and its exposure to all sorts of injury; and when strumous disease does occur the prospect of recovery with a useful limb is tolerably good, provided treatment be early, patient, and judicious. Osteo-arthritis, however, is rather common in later life, and will in all probability impair the use of the joint, and prove a source of pain and trouble during the patient's life. I have already pointed out (p. 277) how the change in shape of the head of the bone, the new cavity which is often worn in the scapula, the erosion of the biceps tendon, and the loss of the mobility of the joint, occurring in this disease, have been confounded after death with effects of partial dislocation. The disease is easily recognised during life by the crackling in the joint and the change in shape of the parts, together with the wearing pain. The treatment is, unfortunately, a less easy problem (see p. 489).

Of the
shoulder.

Inflammation of the shoulder-joint may long exist without suppuration, and its diagnosis from nervous affection demands much care, patience, and attentive examination, under anæsthesia if necessary. Rest and counter-irritation should be persevered in so long as much pain is produced by motion, but no longer. Too long confinement is apt to produce rigidity of the lower part of the capsule, depriving the patient of the power of raising the arm. When suppuration occurs, the matter is often directed by one of the tendons around the joint to a considerable distance, so that the real origin of the discharge is occasionally overlooked for a time. Another source of ambiguity is the occasional occurrence of disease in the bursa which lies between the deltoid muscle and the head of the bone, which does not

communicate with the joint.¹ I once treated a case in which the swelling beneath the deltoid, the pain on motion, and the crepitation which was perceived on rotating the head of the bone led to the diagnosis of disease of the joint. On cutting down through the fibres of the deltoid the bursa was laid open, filled with a mass of lymph and pus ; the joint was found healthy and all the symptoms subsided.

The excision of this joint is so successful that, if the symptoms demand it, no hesitation need be experienced in recommending it. At the same time, the surgeon must remember that the natural cure, by ankylosis, if it can be obtained, usually leaves at least as useful a limb as that after excision, and he should therefore only recommend operation when he thinks the patient is losing ground, or when it seems necessary to hasten the cure.

Of the
elbow.

The elbow is a very frequent seat of strumous disease, beginning either in the synovial membrane or the bone, and in these latter cases going on to carious disease, and in some rarer cases to necrosis. Dislocation very rarely occurs, except of the head of the radius, which is comparatively often found on the back of the outer condyle—a displacement attributed to the hand having been kept in the pronated position. This position should therefore be avoided in disease of this joint, the forearm being placed at an acute (not a right) angle with the arm, and in the position midway between pronation and supination. When abscess has formed and the bone is exposed I am in the habit of recommending excision, provided the patient is in good health. It is true that the disease is limited in many of these cases : in some, after the removal of a sequestrum, or after cutting off a portion of the articulating surface, a cure has been obtained with a moderately useful limb ; and in many a natural cure by ankylosis would ultimately result ; but on the whole it seems that the free excision of the joint is both more certain in its prospects of prompt recovery, and more promising as far as the utility of the limb goes, than either of these other operations.

Chronic rheumatic arthritis of the elbow is generally accompanied with a similar affection of other joints ; otherwise it would be a question whether excision might not be recommended in some of these cases. It is probably this affection which generally is the cause of the occurrence of loose cartilage in this joint. Next to the knee, loose cartilage is perhaps more common in the elbow than elsewhere ; but I never saw a case operated on.²

Of the
wrist and
carpus.

The wrist and carpus are often diseased, and that to a very great extent, and especially at late periods of life, in the class of patients who are met with at hospitals, though far more rarely in persons who are exempt from manual labour. Chronic rheumatic arthritis also attacks this joint, and sometimes produces a pseudo-dislocation, or so changes the relations of the parts that dislocation occurs on some slight injury. The effects of disease of the wrist on the tendons whose action is necessary to the use of the hand are perhaps as formidable as the direct injury to the joint, and when the disease has proceeded far the results of all methods of treatment are imperfect. The early treatment, therefore, of such cases is very important ; but,

¹ The synovial fold which exists beneath the subscapularis, and is spoken of as its bursa, is really a part of the synovial membrane ; and when the infraspinatus has a bursa below its tendon this also forms a part of the joint.

² Hueter excised the elbow in a case in which there were numerous loose bodies in the joint. I once excised this joint for chronic rheumatic arthritis, and with a very good result.

from the circumstances of the patients, it is but seldom that an opportunity is obtained for it. When suppuration has occurred the abscesses should be early and freely opened, the parts should be kept at rest on a splint, and passive motion carefully given to every joint which admits of it, the patient being also encouraged to use as much voluntary motion as he can without much pain.

It is only in the last resort, and as a substitute for amputation, that excision ought to be proposed.

CHAPTER XXIV.

DISEASES OF THE SPINE.

Caries of
the spine.

CARIES of the spine (Pott's disease), or, as it is sometimes called, simply 'disease' of the spine, is very frequent among strumous and other weakly children and young persons, often following on slight accidents, but as often occurring spontaneously—insidious, and marked by few or no symptoms in its commencement, but leading to the gravest lesions in its progress, and very frequently fatal.

It affects any part of the spine, from the highest cervical to the lowest lumbar vertebræ, and, *ceteris paribus*, is more dangerous the higher in the column the affected part is. It has its origin always in the spinal column itself—i.e. in the body of the vertebra, or the intervertebral substance¹—rapidly spreading from one to the other. In the cancellous tissue of the vertebra it seems to originate either in a deposit of tubercle, which softens, or in a low inflammation, leading to suppuration, which spreads through the bone. In the intervertebral substance its pathology is the same as that of other ulcerations of cartilage (see DISEASES OF JOINTS). In some rare cases the inflammation commences in the softening of one or more syphilitic gummata, of which a very interesting example is described and figured by Mr. Barker in his essay on 'Caries of the Spine.'² The morbid process is closely allied to, if not identical with, that of caries as described above (p. 442). There is first vascular engorgement of the cancellous tissue of the bone; probably, in the majority of cases, commencing in that part of the body of the vertebra adjacent to the intervertebral substance. Engorgement is followed by inflammatory exudation and the formation of granulation tissue, which gradually eats away and replaces the bone tissue. The affected vertebræ and intervertebral discs



FIG. 230. Angular curvature of the spine. The preparation is viewed from the right side. There is no difference whatever between the size of the two pleural cavities. The smooth surface, *a*, is a buttress of new bone, the result of inflammation, which has replaced or has soldered together the remains of the bodies of seven dorsal vertebræ. At the side of this is seen a mass of rough, irregular bone by which the heads of the corresponding ribs are ankylosed together. The projecting spinous processes are also firmly united by bone.—From a preparation in the Museum of St. George's Hospital, Ser. v. No. 27.

¹ The disease almost always arises in the bone, but preparations are not wanting showing its occasional commencement in the intervertebral disc.

² 'Syst. of Surg.' 3rd ed. vol. ii. p. 421.

are thus gradually removed, the latter becoming infiltrated with granulation tissue, and being replaced by it in the same manner as the bones, but often resisting the destructive process longer. Then the column gradually sinks together (Fig. 230), the arches and spines of the destroyed vertebræ being thrust backwards along with the spinal cord, forming an angular projection in the back, to which the misnomer 'angular curvature' is sometimes given; while the vertebræ or the remains of vertebræ are now brought into unnatural contact.

The fate of the granulation tissue which replaces the bone differs under different circumstances. (a) It may be absorbed, apparently as the result of the pressure of the vertebræ upon it, as they sink. Under these circum-



FIG. 231. Angular curvature of the spine in the lower part of the dorsal region. The bodies of the lower dorsal vertebræ and the first lumbar have been extensively destroyed by caries. In the neighbourhood of the disease are the remains of the parietes of a thick cyst, at the bottom of which may be seen the thickened theca vertebralis.—St. George's Hospital Museum, Ser. v. No. 18.

stances, an extensive deformity may occur without suppuration and the condition referred to above as 'dry caries' exist. (b) The granulation tissue may caseate and slowly suppurate and become converted into a chronic abscess (Fig. 231), which gradually finds its way to the surface, often spreading to a considerable distance, very commonly passing along the sheath of the psoas muscle into the thigh (psoas abscess), or between the transverse processes, into the loins, (lumbar abscess), or presenting behind the pharynx (postpharyngeal), or (though this is very rare) making its way into some of the neighbouring cavities or viscera, so that spinal abscesses may burst into the pleura, the lungs, the peritoneum, intestines, kidneys, urethra, bladder, &c. (c) The granulation tissue may degenerate into pus before it has had time to destroy and replace the bony material. Under these circumstances portions of bone perish *en masse*, and the condition described in a former page as necrotic caries is set up. (d) The granulation tissue may dry up and calcify; and in

cases where there has only been a very slight destruction of bone, a cure can be effected in this way without deformity.

When under the influence of rest the destructive process is arrested, a reparative process commences in the granulation tissue; and whether the caries has been attended with suppuration or not, this tissue now undergoes a developmental process, and becomes converted into fibrous (scar) tissue, which calcifies and becomes converted into bone, thus firmly welding and uniting the remains of the vertebræ together in this new position, and so effecting a cure of the disease.

In some cases of caries of the spine the enormous loss of stature which many of these persons present shows how extensive may be the destruction from which a patient may recover without loss either of life or of spinal power.

At the same time the disease is very often fatal by itself, the patient dying either from exhaustion, or from the inflammation of the sac of the abscess, or from inflammation of or pressure on the cord, or from some complication, such as the bursting of the abscess into the peritoneal cavity; and a good many such patients die of concomitant internal disease, chiefly phthisis.

The immunity which the cord so commonly enjoys in disease of the spinal column, even when the latter is of very great extent, is so remarkable a phenomenon that we must endeavour to give a distinct explanation of it, as well as of the nature of the affection of the cord when it does occur. The reasons why the cord commonly escapes disorganisation from pressure or inflammation are threefold: (1) the very gradual progress of the change of form in the column allows the spinal cord to accommodate itself to its new position: also, we must not forget that the vertebral canal is much larger than the cord; (2) the gradual falling forward of the upper part of the column pushes the abscess forward, as shown in Fig. 231, and prevents it from making its way towards the spinal canal, and propagating inflammation into its interior; and (3) the theca vertebralis protects the medulla from implication in the affection of the column. For these reasons the spinal marrow generally escapes both pressure and inflammatory softening; but it does not always do so. In rare cases, as the result of sudden giving way of the column, either spontaneously or from violence (as in the well-known case in which a quack undertook to straighten the column in a case of caries), the cord may be crushed, just as in any other case of fracture of the spine, with the same result of instantaneous and total paralysis of motion and sensation, which will in all probability be permanent. More commonly the spinal cord is affected only by inflammatory changes in its anterior portion, or possibly by partial pressure, either from abscess pressing on it in front or from bending at the angle; and in such cases only the motor roots of the nerves are implicated, and sensation is perfect. It is much rarer for sensation to be affected as well as motion; and for sensation to be alone affected seems to be unknown.

Many such cases of paraplegia end in recovery, but in some the lower limbs remain withered and paralysed. The paralysis of the sphincters is almost always temporary.

The diagnosis of caries of the spine is by no means easy in all cases. When there is no abscess perceptible, and no curvature, the symptoms are, pain in the back in a fixed spot, increased by movement, and particularly



FIG. 232. Compression of the cord by a displaced fragment, in caries of the spine. The seventh and ninth dorsal vertebræ have been partially destroyed, while the body of the eighth is represented only by an angular fragment between them, which has been thrust backwards so as to compress the cord. Paralysis, however, was not total.—From a drawing (Ser. xxi. No. 40) presented by Sir B. Brodie to the Museum of St. George's Hospital.

by percussion, of the affected part of the spine, sometimes to an exquisite degree ; tenderness confined to the spinal column, and possibly some amount of thickening, or even of increased temperature, around the diseased bones. The affected part of the spine is kept rigid, producing a very characteristic attitude when the disease is situated in the upper part of the neck. Pain is often complained of at the peripheral terminations of the nerves which arise near the seat of the disease. Thus the child may complain of an ill-defined superficial pain round the trunk, a sense of constriction round the belly, or a pain at the pit of the stomach. Hysterical or neuralgic pain often closely simulates caries, but is not so constant and equable ; it is usually accompanied by tenderness, not of the spine only, but diffused over the back, and frequently joined with other symptoms of hysteria, or with uterine disturbances. The growth of a tumour from the vertebræ may at first be indistinguishable from caries, but the progress of the case will soon clear up all doubt. Frequently the early stages of caries are not accompanied by any decided symptoms, and I have seen even large abscesses connected with extensive caries of the spine discovered in post-mortem examination of persons who have never made any complaint leading to the suspicion of such a disease. When curvature exists there is no longer room for doubt ; in some few cases, indeed, lateral curvature does to a certain extent simulate angular ; but an attentive examination will usually clear up the case.

Spinal abscess is generally psoas or lumbar. Little more need be said about lumbar abscess. It presents at the outer edge of the erector spinæ muscle, between the ilium and ribs ; and the only questions which occur in its diagnosis are usually whether it is a simple abscess or one caused by diseased bone, and in the latter case whether the disease is in the spine or pelvis. These questions will be settled by the symptoms and by examination of the parts. When the pelvis is diseased it can often be felt with the probe ; but the spinal disease, being situated on the front of the column, is out of reach.

Abscess
from
diseased
spine.

Psoas abscess, however, constitutes a distinct surgical disease, the diagnosis of which, as well as its treatment, requires special rules. The disease in the spinal column which gives rise to it is often seated about the origin of the psoas muscle, the pus travelling down the front of the column in the posterior mediastinum till it makes its way beneath the ligamentum arcuatum internum, and so gains the sheath of the psoas—sometimes on both sides. It then travels down the loins, forming a fulness which can often be distinctly recognised at the side of the lumbar spine, and sometimes irritating the muscle so as to produce flexion of the thigh and pain on attempts to extend it.¹ It then fills the iliac fossa, passes beneath Poupart's ligament on the outer side of the vessels, and crosses beneath the femoral sheath to the inside of the thigh, where it usually stops, presenting and bursting just below the groin ; but in rarer cases it may travel a long distance down the thigh before it bursts. The diseases with which psoas abscess is likely to be confounded are femoral hernia, simple abscess, cystic tumour, cancer, and aneurism. Like femoral hernia, it often has a distinct impulse. Its orifice of communication with the iliac fossa and the portion of the abscess external to the vessels is often so small as not to be readily discovered. But the fulness in the iliac fossa is usually quite sufficient to distinguish it from hernia, even if the pain in the spine and deformity be absent. And although a psoas abscess may be to a certain extent reducible on pressure in the recumbent

Psoas
abscess.

¹ Similar flexion and pain may, however, exist in sacro-iliac disease (see p. 503) and in disease of the pelvis.

position, this is merely a diminution of size, quite different from the sudden and complete disappearance of hernia. From simple abscess and from cystic or bursal tumour the spinal symptoms and the fulness in the iliac fossa are sufficient marks of distinction. Cancer may simulate abscess in this as in other regions, but the diagnostic marks are numerous. Singularly enough, the disease which most closely resembles psoas abscess is that which would at first sight appear to be farthest removed from it, viz. aneurism, at least that form of disease of arteries to which the somewhat unmeaning name of diffused aneurism is given, i.e. a collection of blood communicating with a diseased artery, and which is often caused by the rupture of a small pre-existing aneurism, at other times by the giving way of a small portion of the artery. The growth of an abdominal aneurism against the spine often gives rise to wearing pain in the back, from absorption of the vertebræ; the tumour, in some cases, does not pulsate, and it grows down the loins just as a psoas abscess would do. So close is the resemblance that the mistake has been committed by some of the best surgeons.¹ Doubtless, in most of these cases auscultation would reveal a bruit; and this, though it might not be decisive of the nature of the disease, would at least induce caution in opening the tumour, and a preliminary exploration with the grooved needle, if the surgeon should still desire to make the opening.

Treatment
of spinal
abscess.

When the diagnosis of psoas abscess has been established the question of treatment occurs. The patient must be confined to bed and kept in the strictest repose for a very long period. It is better not even to allow him to rise from his back, but merely to turn from side to side; but it is not always easy to enforce such complete repose. At the same time his strength must be supported by nourishing diet, without stimulants, and cod-liver oil or iodide of iron may be administered internally if they agree with the digestion. In fact, the general treatment must be regulated by the constitutional condition. But the main question is whether to open the abscess or not. As a general rule I have no doubt that it is better to open these abscesses as soon as they come within a convenient distance from the skin, or indeed even earlier if there is evidence that they are rapidly increasing in size. This should be done in the manner described by Sir. J. Lister, i.e. by allowing the pus to ooze gradually through a veil made of lint or muslin saturated with carbolic acid lotion, which is to be replaced by the usual antiseptic dressings after the oozing has almost ceased. If the patient be a child, the plan which I usually adopt—and, I believe, with benefit—is to open the abscess in a carbolic bath. The child is placed in a warm bath, to which carbolic acid (1 in 80) has been added, so that the pelvis and lower part of the abdomen are completely immersed. The abscess is opened, an anæsthetic having previously been administered, and allowed to drain away into the bath. A counter-opening is then made in the loin, following the plan advocated by Mr. Treves, and the finger introduced and the seat of the caries explored. If any necrosed portion of bone is discovered it is removed. The abscess is syringed out with carbolic lotion, drainage tubes introduced, and the wounds covered with carbolic gauze, which is to form the deep dressing. The child is now removed from the bath, laid on a blanket, and rapidly dried. The rest of the dressing is then proceeded with. Mr. Treves² advocates opening an abscess connected with caries of the last dorsal and lumbar

¹ See a paper on the Diagnosis of Aneurism, 'St. George's Hosp. Reports,' vol. vii. p. 192.

² 'Med.-Chir. Trans.' vol. lxxvii. p. 113.

vertebræ by a direct incision in the loin. I prefer, however, to open the abscess first in the groin, *above* Poupart's ligament, and then passing a long probe through this opening as far as it will go, cutting down on the point of it, taking care to cut opposite a transverse process and not between them, for fear of wounding a lumbar artery. By making two openings more perfect syringing can be accomplished, and there can be no collection of matter in the lower part of the abscess, as I have seen take place when only one opening is made in the loin.

Free opening of the abscess seems to me far better than the treatment by aspiration; and if antiseptic precautions are fully carried out there is no fear of septic absorption, which, if it occurred, would be marked by rigors, fever, swelling, redness, and œdema around the puncture, and foulness of the discharge. This is a dangerous occurrence, likely to lead to death directly

from fever or septicæmia, or indirectly from exacerbation of the disease in the bones. Free incision, washing out the cavity with antiseptics, vigorous stimulation, and support are the measures which should be adopted. When the abscess has healed, or remains in the state of a mere inactive sinus, the treatment resolves itself into that of spinal disease only. And the treatment of spinal disease really resolves itself into mere rest—that is to say, the bones themselves should be kept at rest, and all the muscles which act upon them, as far as is possible. So long as the patient can be kept in bed without detriment to his health, he is better

Treatment
of disease
of the
spine.

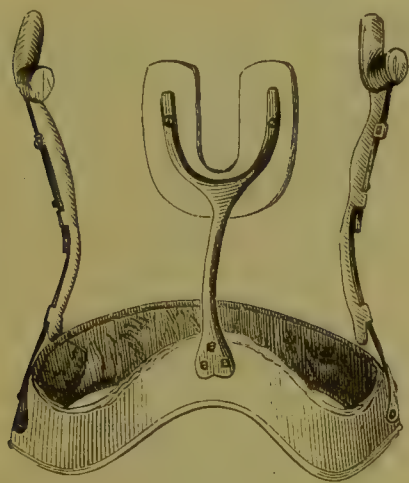


FIG. 233. Apparatus for supporting the spine and receiving the projecting vertebrae, in a case of angular curvature.

there than moving about; or the bed can be placed on a carriage and he can be wheeled into another room or into the fresh air. There can be no question that during this period of treatment the prone position is the best; and it is astonishing how soon the patient becomes accustomed and reconciled to this position, in which he experiences a greater degree of comfort than in the supine posture or on his side, and in which the projecting angle of the curved spine is not injuriously compressed. When it seems expedient, on account of his suffering from confinement, and the bones appearing to be sufficiently soldered, an apparatus may be constructed by which the weight of the upper part of the body is taken off the spine and transmitted through crutches supported on rigid rods to a girdle resting on the pelvis. This should be worn even for a considerable time after it is believed that the bones have become ankylosed. The symptoms of such ankylosis are the disappearance of pain on motion, the wasting of the muscles in the intervertebral gutters, and the fact that all the vertebræ move together when the back is bent. It need hardly be added that no attempt should be made to rectify the curvature, which, in fact, is a necessary part of the cure, and which often becomes more marked as consolidation becomes perfect and the soft parts waste around the ankylosed bones.

Lately an ingenious—and, I believe, a successful—method of treatment has been introduced by Dr. Sayre of New York, with a view of ensuring local rest for the diseased parts, and at the same time allowing the patient the

Sayre's
treatment
for spinal
curvature.

inestimable benefits of fresh air and exercise. The patient, who has a flannel shirt or jersey over the chest and abdomen, is to be suspended in a tripod-frame by the shoulders and neck so that his feet just touch the ground; and in doing this the weight of the body somewhat extends the spine and reduces the curvature to its minimum—at least straightens the column as much as is prudent. Then a pad or a lump of wadding is to be applied to the projecting vertebræ so as to avoid any pressure on the skin over the hump, a pad is placed over the region of the stomach (the ‘dinner pad,’ as Dr. Sayre names it), and the whole thorax and abdomen is rapidly enclosed in a case of plaster. When this is completed the abdominal pad is drawn out, and the patient is laid horizontally on a mattress or on a water-bed while the plaster is setting. If it be a female adult, the breasts must also be padded. When the whole has set the patient may be allowed to take exercise, though, of course, with caution.

This treatment has been extensively tried, and the general verdict seems decisive in its favour.¹ When, however, deformity has taken place and there is a distinct prominence of one or more spinous processes, I am decidedly of opinion that it is better to apply the plaster-of-Paris jacket without suspension, as recommended by Sayre. When deformity has occurred there must have been destruction to a greater or less extent of the bodies of the vertebræ, and the act of suspension tends to separate the displaced vertebræ from each other and produce a gap or space which is not likely to be filled up by new bony deposit; whereas if the spine is ‘put up’ in a plaster jacket in the position which it has assumed, it serves to fix the vertebræ in contact with each other, and consolidation rapidly takes place. It is true that the deformity is thus rendered permanent, but this is preferable to a continuance of the disease or to a want of ankylosis of the bony surfaces.

Disease of
cervical
vertebræ.

Disease of the cervical portion of the spine deserves special notice. It is much more fatal than the similar affection of the lumbar or dorsal regions, and it has both special characters and special dangers of its own. The disease is, I think, even more common in childhood, relatively to adult life, than that of the other regions of the spine, and it usually at first simulates mere ‘stiff neck,’ the pain on motion causing the child to hold its neck stiff. When the disease attacks quite the upper end of the column, so that the movements of the head produce an immediate effect on the carious bones, the child gets a habit of keeping the head instinctively but very carefully fixed in a certain position which is very characteristic, and in turning often turns the whole body, and steadies the head with both hands. Often a slight tap on the top of the head will produce pain. There is usually thickening around the affected vertebræ, very rarely any curvature, the small size and deep position of the spines preventing any recognisable angular deformity; often sinuses about the neck, and frequently postpharyngeal abscess, which causes a swelling or opening at the back of the pharynx (Figs. 234, 235). The chief danger in this disease is that of softening of the upper part of the cord, leading to dyspnoea and speedy death. But another and still more sudden mode of death is that which results from displacement of the odontoid process in disease of the two upper vertebræ, and which is illustrated by the Figs. 236, 237. The former (Fig.

¹ The reader will find this method of treatment fully discussed in the ‘Transactions of the International Medical Congress,’ Section on Diseases of Children, and the more recent experience of the inventor and others is summarised in the report of a discussion at the British Medical Association meeting in 1884 in the ‘Brit. Med. Journ.’ Aug. 6, and Sept. 20, 1884.

236) shows all the ligamentous apparatus connected with the odontoid process destroyed, with the single exception of a small string of the transverse ligament which has escaped destruction, the patient having died from the extensive affection of other parts of the vertebral column. Had he lived somewhat longer the slight remains of the transverse and check ligaments would have given way, and the same result would have followed as that which is shown by the other figure (Fig. 237). This was taken from the body of a girl aged nine, who had been for some time in St. George's Hospital, with disease of the upper part of the spinal column. One day the nurse was raising her head to wash her, when she fell back dead. The figure shows that the whole ligamentous apparatus which confines the odontoid process has been destroyed; and that process, being suddenly displaced backwards and upwards, has impinged on the medulla and produced instant death. The same accident has happened in cases where (as in that which furnished Figs. 234, 235) there had been no previous suspicion of disease of the spine. Thus a lady was sitting in her



FIG. 234. Caries of the cervical vertebræ and ulceration of the intervertebral discs, communicating with the pharynx by an ulcerated opening. The membranes of the cord were found united to each other and to the posterior surfaces of the vertebræ, and the upper part of the cord was softened. *a*, section of the basilar process; *b*, the opening in the pharynx communicating with the diseased spine; *c*, the epiglottis, with a portion of the tongue below it. The symptoms were so slight that the ulcer in the pharynx was not known to have any connection with diseased spine till the post-mortem examination. The patient died suddenly, after being in the hospital for a few days.



FIG. 235. The back view of the same preparation, showing: *a*, the base of the skull; *b*, the opening of the pharyngeal abscess; *c*, the posterior common ligament and theca vertebralis, thickened and turned down, in order to show the diseased bone and the opening of the abscess; *d*, carious and exposed surface of some of the lower vertebræ.—From a preparation in the Museum of St. George's Hospital, Ser. v. No. 13.

chair, and, turning her head to greet a person entering the room, fell dead. Another was playing with her child, who pulled her head back, and she died on the spot. In both cases the displacement of the odontoid process was found.

In order, then, to guard against the risk, not merely of this fatal displacement of the odontoid process, but also of the irritation of the spinal cord and of the extension of the disease of the bones by movements of the affected vertebræ, the most rigid rest must be insisted on. It is not enough merely to put the patient to bed. The head and neck ought to be confined in a case of plaster or gutta-percha, in the moulding and applying of which all imaginable gentleness should be used;¹ and the patient must never be allowed to rise

¹ This is better, on the whole, than putting the head and neck into a kind of sandbath, as is sometimes recommended, or fixing anything on the couch to contain the head, since

from the horizontal posture, the sheets being so arranged that they can be changed without raising him. This rigid rest must be continued until the pain on motion of the head has ceased for some time. In the later stages of the disease, and after all active mischief has subsided, or in very chronic cases, it is not desirable that the patient should be kept in bed; and many apparatus have been employed in order to fix the head and take off the weight from the spine so as to enable the patient to go about. The one most commonly in use is Sayre's 'jury-mast' (Fig. 238). This consists of a plaster jacket, to the back of which is fixed a light bar arching overhead, and having a cross-bar at its extremity, to which are attached straps to pass under the chin and occiput and support the head. Mr. Owen¹ recommends a 'cervical collar' moulded from leather, which supports the chin and keeps the head fixed. Mr.

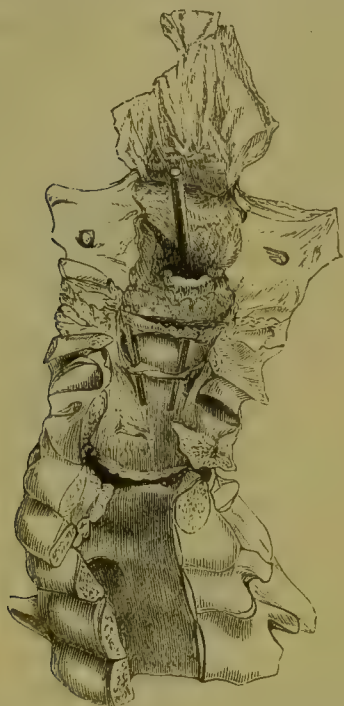


FIG. 236. Disease of the skull and upper part of the spine, in which the transverse ligament has been almost entirely destroyed. There is a large opening, through the base of the skull (occipital and sphenoid bones), communicating with the pharynx, through which a rod is passed. Below this the odontoid process is seen exposed by the ulceration of the transverse ligament and its vertical appendage. Only a thin string remains, under which two black bristles are passed. The odontoid process, however, is still retained in position by some remains of the check ligaments. The connections between the second and third vertebrae are almost destroyed. The flap turned up at the top of the preparation consisted of the dura mater, covered externally by a quantity of thick scrofulous matter, which had produced pressure on the spinal marrow.—From the Museum of St. George's Hospital, Ser. v. No. 14.



FIG. 237. A preparation showing displacement of the odontoid process backwards from ulceration of the transverse and check ligaments in disease of the upper part of the spinal column. Death was instantaneous.—St. George's Hospital Museum, Ser. v. No. 15.

Walsham² recommends a somewhat similar contrivance, consisting of a poroplastic felt jacket, together with an accurately fitting collar and helmet-piece. Dr. Fleming³ has invented an india-rubber inflating-bag, which, when adjusted over a broad stiff collar and distended with air, supports the head and to a certain extent fixes it. And, lastly, Mr. John Moore,⁴ of Linwood, near Paisley, has invented an appliance, consisting of two incomplete rings

these will not move along with the patient when it becomes necessary to move him; but of course the making of the splint involves some risk.

¹ 'Brit. Med. Journ.' Oct. 31, 1885, p. 824.

² Ibid. p. 826.

³ 'Glasgow Med. Journ.' May 1884.

⁴ 'Brit. Med. Journ.' Oct. 31, 1885, p. 825.

of steel, which are continuous behind, where they are incomplete ; the upper one of which supports the chin, and the lower rests on the shoulders. In other respects the treatment is the same as in disease of other portions of the spine.

Next in frequency to angular curvature, if not even more common, is what is usually called lateral curvature of the spine ; though, as the curvature is not in ordinary cases merely to one side, but each vertebra is also somewhat rotated on that next to it, the distortion is sometimes called ' rotation curvature.' The annexed illustration (Fig. 239) shows the spine in a very extreme example of this deformity, so extreme that the atlas in the erect position is only a few inches above the sacrovertebral prominence ; and it will be observed that the spine is so rotated that there are vertebræ which look towards each side, and some which are directed almost backwards. This rotation of the

Lateral
curvature
of spine.

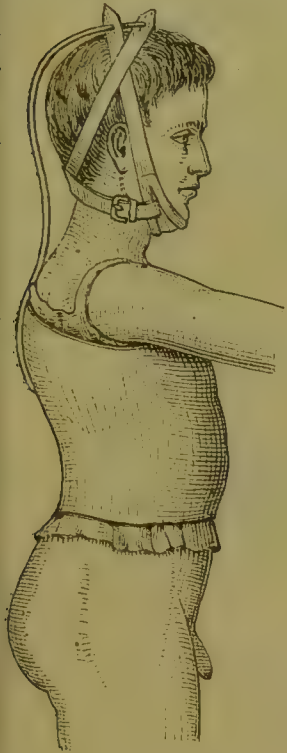


FIG. 238. Jury-mast applied.

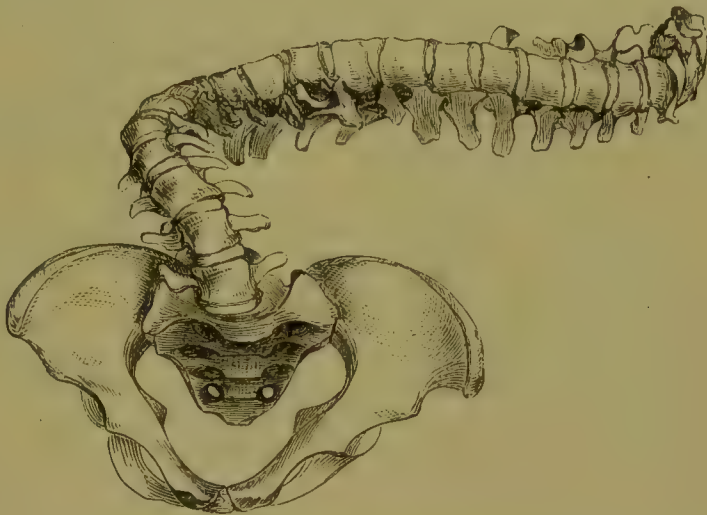


FIG. 239. A preparation of extreme lateral curvature (or ' rotation curvature ') of the spine.—From the Museum of St. George's Hospital.

vertebræ is obviously caused by some active force which can only be exercised by the muscles inserted into them. The original cause of the distortion, however, appears to be merely passive. The deformity commences in almost all cases about the period of puberty,¹ and in girls far oftener than in boys, the patient being weakly and sickly from confinement, and possibly over-study, or from menstrual irregularity. In such persons anything which produces habitual inclination of the spine to one side, as the habit of standing on one leg, acting on the lumbar spine, or the habit of carrying a burden (such as a nurse-child) on one arm, acting on the dorsal region, may prove the starting-point of more extensive deformity. The muscles are now thrown into irregular action ; and as the attachments of the muscles on the convex side of the curve are approximated their fibres become indurated and thrown into chronic action, while the stretched muscles on the other side are proportionally weakened and inactive. The displaced vertebræ are also changed in shape by pressure, so that when the deformity has lasted long the bodies

¹ Eulenberg says that in Germany the disease begins earlier than this—from six to ten years of age—and refers the earlier origin of the disease there to the earlier period at which children are put to school. See ' Lond. Med. Record,' 1877, p. 432.

of the vertebræ are much thicker on the convex than on the concave side of the curve, and the transverse processes are almost locked together, and the deformity is, at that stage at least, incurable. When the spine, in either the lumbar or dorsal region, is thus primarily curved a somewhat similar secondary incurvation commences in the dorsal or lumbar region, produced by the efforts necessary to maintain the balance of the body. This secondary curve is, however, always less marked than the primary one. A third compensatory curve in the cervical region may sometimes be traced in cases of extreme lateral curvature, as in Fig. 239. Lateral curvature in the dorsal region produces, in the first place, a displacement of the ribs and scapula upwards on the convex side of the curve, so that that shoulder is raised higher than the other. This is commonly on the right side; and the first thing which attracts attention is the 'growing out' of that shoulder, as it is termed. When the deformity is extensive and confirmed, the thorax will be greatly altered in shape, so that the ribs are flattened down, the intercostal spaces nearly obliterated, and the cavity for the lung greatly narrowed, while on the other side it is the reverse. In the lumbar curve the distance between the last rib and the ilium (i.e. the flank) is much increased on the convex side of the curve, while on the concavity it is so much diminished that the patient is sometimes annoyed by the rib impinging on the ilium; this produces considerable falling in of that flank. The hip also is raised and prominent on the convex side of the curve.

The diagnosis is generally simple. The patient being stripped, the line of the spinous processes should be dotted with ink as she stands with both feet flat on the ground and planted together. She should then be made to stoop; the position of the shoulders should be compared, the distance between the ilium and last rib on either side ascertained, and the extent of the thoracic and lumbar curvatures compared. The only affections of the spine which it is possible to confound with lateral curvature are: *a*, curvature from caries; *b*, curvature from rickets; and *c*, curvature from empyema. In some very rare cases of caries of the spine the sides of the bodies are either entirely or chiefly affected, and the spine falls to one side instead of directly backwards; but on attentively investigating the history of such a case there is never any difficulty in discovering its nature; the curve is always limited to a few only of the vertebræ instead of being diffused over the whole region, and is always accompanied by more or less of angular deformity. The curvature from rickets is usually also of an irregular kind, the softened vertebræ projecting backwards as well as to one side. It commences at quite a different period of life from the ordinary lateral curvature, and is generally, if not always, accompanied by deformity of other bones, as the legs or forearms. The curvature which follows on empyema is a truly lateral curvature, accompanied by no rotation, and is always easily distinguished from lateral curvature by the history and by the sinuses.¹

Having fixed the diagnosis, the next thing which is to be done is to ascertain the cause and how the disease has commenced. If it has commenced in the lumbar region as a consequence of inclination of the pelvis depending on unequal length of the limbs (as in diseased hip), the first step in the treatment is obviously to restore the length of the limb by a proper boot, and thus to act on the pelvis. If it seems to depend on a habit of standing on one leg or of dropping one shoulder, that habit must be corrected, and the patient carefully

¹ On the difference between the ordinary lateral curvature and that from empyema, see Dr. Little, 'Syst. of Surg.' 3rd ed. vol. ii. p. 441.

drilled. Any habitual exertion that tends to distort the spine (as carrying a weight, working at a one-armed trade, &c.) must be given up. Gymnastic exercises which call the muscles of the two sides of the body into equable action are extremely useful, under careful supervision, in the early stage of the disease. A long rest in the recumbent position, and with the body in a perfect state of extension, in the middle of the day, after dinner, is also very desirable, as avoiding over-fatigue. The general health must be cared for, and steel is generally indicated. An apparatus (Fig. 240) used formerly to be applied to press gently on the convex side of the curve in the back and to separate the ribs from the ilium in the concavity of the loins, but is now believed to be of very little use, and is very rarely employed. When the curve is pronounced and the disease inveterate, nothing can be done to correct the existing de-

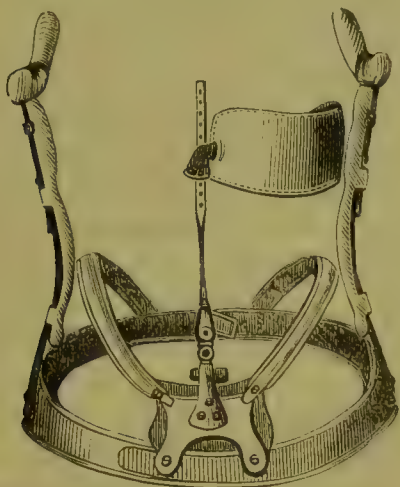


FIG. 240. Apparatus for supporting the spine and pressing the projecting part of the thorax and spine towards the middle line in a case of lateral curvature.

formity, though the application of an instrument may be still advisable, in order to prevent it from increasing.

Dr. Sayre's treatment, described above, has been tried in cases of lateral curvature also, and seems to me very applicable to such cases. But here great care must be taken, in applying it, to see that the spine is straightened as much as possible before the plaster is applied; and I think the dressing should be frequently renewed, in order to see that it does not injuriously confine the parts, and also to renew the extension. On this account the poroplastic felt jacket is preferable to the plaster-of-Paris one, since it can easily

be taken off, for purposes of examination and cleanliness, and can as easily be reapplied. Care must be taken that the jacket should always be reapplied whilst the patient is suspended.

Recently many practical surgeons have come to the conclusion that these cases are better treated, without any mechanical appliance whatever, by removing, as far as possible, the exciting causes of the deformity; by improving the general health and muscular tone, and at the same time combining a judicious selection of muscular exercises with partial recumbency. And there can be no question that in the earlier stages of the disease, before there is much structural change and confirmed rigidity, much may be done in this way to lessen the deformity and effect a cure. In this country, we are much indebted to Mr. Roth for the attention which he has drawn to this plan of treatment and to the care with which he has worked out its details. The following are briefly the lines on which Mr. Roth conducts the treatment of these cases:—*a.* He re-educates the patient's muscular sense as to an erect and improved position, by inducing her to assume such a posture by a voluntary effort before a looking-glass. *b.* He instructs the patient to maintain this improved position at all times, whether sitting or standing. *c.* He takes care that no article of clothing shall interfere with the resumption of an improved or perfectly normal position of the patient's spine and trunk. *d.* He attends to the patient's general health. *e.* Finally, he systematically trains the spinal and other muscles by a series of exercises, for the description of

which space cannot be found in this work, but which the reader will find given in full by Mr. Roth in the 'British Medical Journal,' May 13, 1882.

Other |
spinal cur-
vatures :
kyphosis ;
lordosis.

The other curvatures of the spinal column are kyphosis, or the general antero-posterior curve which is common in weakly children and in old men ; and lordosis, or the incurvation of the bodies of the lumbar vertebræ forwards. The term kyphosis is sometimes applied to all antero-posterior displacement, including angular curvature ; but it seems to me better to speak of the latter by itself. Kyphosis occurs in early infancy from mere relaxation. In fact, the spine has no pronounced curves in early life, and when the baby is made to sit up for a time the back will always be found to be bowed ; but this bend is only temporary, and is effaced by suspending the body from the shoulders. Weakly children suffer in the same way from what is called in schools 'cat's-back'—the chin poking forward and the spine projecting often to such an extent that the case is mistaken for one of incipient angular curvature. But attentive examination shows that the curve is uniformly distributed, unaccompanied by pain or inflammation, and capable to a great extent, if not entirely, of obliteration by gentle extension or suspension. It will disappear with rest, strengthening, and correction of any lazy habit of stooping ; or, if extreme, some bandage to the back may be necessary. The kyphosis of old age can hardly be mistaken. It is not susceptible of more than partial relief from rest and support.

Lordosis, or saddleback, is caused chiefly by disease or congenital dislocation of the hip (Fig. 229, p. 502). It is therefore a secondary change, the treatment of which must consist mainly in the correction of the primary displacement. The forward inclination of the pelvis which produces the lordosis is necessitated by the backward displacement of the centre of gravity of the body caused by the dislocation of the hip. Hence the first step is, if possible, to remedy this displacement. This may be sometimes effected, in congenital dislocation, by fixing the head of the bone, if movable, in or near its natural position, or in ankylosis by dividing the neck of the bone and putting the limb straight. When this has been done extension by an appropriate instrument will diminish the lumbar curve, though it is not probable that it will succeed in wholly rectifying it.

Ankylosis.

Ankylosis of the spine is another condition not very uncommon in old age, and is one of the causes of the rigidity of the spine in advanced life, though by no means the only or, perhaps, the most common. It is probably allied to or associated with chronic rheumatic arthritis. The anterior common ligament is often in these cases found converted into a mass of bone, and the ossification seems to have invaded also the intervertebral discs. It is, of course, incurable.

Cancer of
the spine.

Tumours of all kinds may be found in the spinal canal, but I cannot spare the space required for their detailed description, nor do I consider it necessary. The symptoms are those of irritation or of pressure on the cord, together with absence of proof of any disease in the bones ; but the diagnosis is seldom made quite confidently till a post-mortem examination shows the nature of the tumour.¹ The only other affection I shall speak of is the sarcomatous

¹ Mr. Victor Horsley has recorded a case in which he removed a myxoma about the size of a filbert from the spinal canal, which was compressing the spinal cord and causing

deposit which is found in the bones of the spinal column, as a primary disease, and the carcinomatous as secondary to cancer in other parts, and especially to scirrhus of the breast.¹ The disease is seen at all periods of life (Mr. Hawkins relates the case of a child five years of age), but is more common after middle age. The symptoms are often very severe—great pain, severe muscular spasms from irritation of the nerves emerging from the affected portion of the spine, paralysis more or less extended, rapid emaciation, and death. When the disease occurs primarily the diagnosis can only be confidently made if the tumour can be felt; though the severe localised pain and the rapid wasting may cause a suspicion of the nature of the malady. In cases where cancer in other parts has preceded, or is still present, less hesitation will be felt.² All that can be done is to soothe the patient's sufferings by the free use of narcotics, and to insist on total rest.

Spina
bifida.

Spina bifida is a tumour formed by a congenital hernia of the spinal membranes (dura mater and arachnoid) through a cleft left in the arches of the vertebræ by incomplete coalescence of their laminæ. The disease is more common in the lumbar than in any other region (though it may occur in either the cervical or the dorsal), and this is consistent with the fact that the closure of the arches takes place gradually from above downwards. As in the analogous tumours in the brain (meningocele), there is not only want of closure of the bones, but also dropsical effusion in the sac of the membranes. The sac of the tumour is formed by the skin and the dura mater and arachnoid, but it always contains the cerebro-spinal fluid (*spinal meningocele*). Sometimes also the pia mater and the cord, or in the lumbar region the nerves of the cauda equina, are carried into the sac (*meningo-myelocele*), and united to it in the middle line (Fig. 241); and again, sometimes the central canal of the spinal cord becomes dilated and forms the sac cavity, the inner lining of which consists of the expanded and atrophied substance of the cord (*syringo-myelocele*). In some cases the skin is more or less deficient over the tumour, exposing the membranes, through which the fluid shines as through a thin bladder. On the other hand, the skin has been found much thicker than natural. There are often other deformities, such as clubfoot, harelip, hydrocephalus, or meningocele; and, if the child survives, permanent paralysis of the sphincters or paraplegia may result. But as a general rule such children do not long survive. The tumour often bursts, and fatal convulsions come on, or the child is too weakly to resist some of the ordinary ailments of infancy. Still there are cases on record in which a person with spina bifida has been known to survive to and beyond middle life³ without any apparent drawback from the disease; and at least one remarkable instance is recorded in which a tumour which was believed to have been a

acute pain, with complete anæsthesia and paraplegia in the parts below, by removing the spines and laminæ of the greater part of the third, the fourth, and the fifth dorsal vertebræ. The patient recovered, and gradually his pain diminished, and motor power returned to his lower limbs, so that after seven months it had become almost natural.—

'Brit. Med. Journ.' vol. i. 1888, p. 191.

¹ See Cæsar Hawkins's 'Contributions to Path. and Surg.' vol. i. p. 380. 'Med.-Chir. Trans.' vol. xxiv. p. 45.

² I saw a singular case of cancer once, in which, after severe pain in the spine, but without paraplegia, one of the vertebræ was found to crepitate distinctly on the other. After a few days this symptom disappeared, the soft mass having grown in between the two vertebræ.

³ In a published case the patient survived to the age of fifty, and I have heard of older cases in private. See Holmes's 'Surg. Dis. of Childhood,' p. 83.

spina bifida (though it was more probably a meningocele) gradually lost its communication with the cerebro-spinal canal, and was removed from the back of the neck as a simple cyst;¹ and other instances of spontaneous cure are recorded. Viewing, then, the great danger of any effectual surgical treatment, it seems better to watch the case carefully, and not to interfere unless the tumour is growing. In that case the tumour should be tapped with a fine trocar on one side, since when the nerves are in the sac they always adhere in the middle line, and as much of the fluid should be drawn off as will decidedly relieve the tension. A shield or compress of gutta-percha, well padded, should then be applied. Under this treatment, by repeated tapping, some cures have been effected.² In other cases there seems no doubt that a radical cure has been produced by the injection of tincture of iodine. The plan which has had most success is that introduced by Dr. Morton of Glasgow.³ He uses a solution of iodine gr. x. and iod. of pot. ʒss. in an oz. of glycerine, of which about half a drachm is injected into the sac after the tumour has been about half-emptied. Every precaution must be taken to avoid the entrance of air during the operation, and to keep the puncture securely closed afterwards. It may be necessary to repeat the injection. A recent volume (vol. xviii.) of the Clinical Soc. Trans. contains a very interesting and complete report on Spina Bifida and its treatment by Morton's method, to which I would refer the reader for many details of the pathological anatomy of the disease and the results of various methods of treatment for which my space is insufficient. The reporters believe that the treatment by iodine injection is the one which most nearly imitates the process of natural cure, and is therefore most widely applicable, and they formulate their conclusions on the subject as follows:—

‘1. Notwithstanding many failures, the plan of treatment by injection is the best with which we are acquainted, and the only one which we feel justified in recommending.

‘2. A more careful selection of cases than has hitherto been made is necessary.

‘3. Marasmus, hydrocephalus, and intercurrent disease contra-indicate the operation.

‘4. In cases in which the operation may, nevertheless, be legitimately performed, we should consider the following as unfavourable circumstances:—

‘a. Distinct evidence of the cord being in the sac, as shown by umbilication or a longitudinal furrow.

¹ Solly, ‘Med.-Chir. Trans.’ vol. xl. p. 19.

² Sir A. Cooper, ‘Med.-Chir. Trans.’ vol. ii.

³ ‘The Treatment of Spina Bifida by a new method.’ Glasgow, 1877.

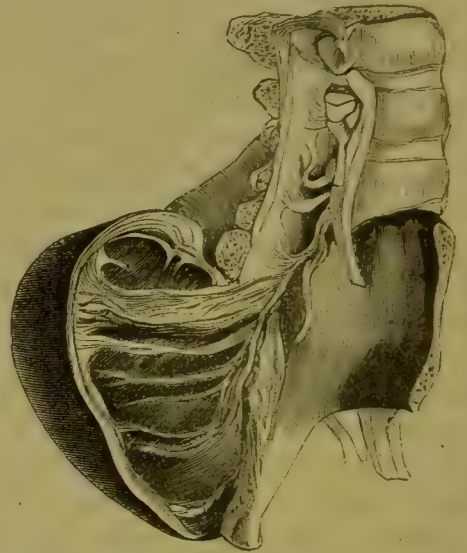


FIG. 241. Spina bifida, taken from a child who died a fortnight after birth, the immediate cause of death being sloughing of the parietes of the sac. The arches of the three lower vertebræ and part of the sacrum are deficient. The cauda equina passes into the tumour, and some of the nerves are spread out upon the inner wall of the sac, whilst others intersect its cavity.—St. George's Hospital Museum, Ser. v. No. 54.

- ‘ β . A very thin membranous or ulcerated sac.
- ‘ γ . Previous rupture of the sac.
- ‘ δ . The occurrence of a distinct impulse between the tumour and the anterior fontanelle ; or a sac, the contents of which are easily returned into the spinal canal.
- ‘ ϵ . A very early age of the patient.

‘5. The best result is to be hoped for in children, who have reached the age of two months, in whom there is no paralysis or hydrocephalus, and when the sac is covered by healthy skin.’

Attempts have been made in tumours which are pedunculated—and which, therefore, are less likely to contain the cord or nerves—to obliterate the neck by the gradual pressure of a clamp ; and such tumours have even been successfully removed.¹ It must be left to the surgeon’s own judgment whether he thinks it justifiable to risk this last resource. The pedunculated condition of the tumour and its high position are doubtless favourable circumstances for the success of the attempt. Yet it might be argued that such tumours would very probably remain inactive. I have never but once performed the operation myself, and then on a tumour in the loins, in the case of a girl *æt.* 8, whose life was rendered intolerable from permanent paralysis of the sphincters ; but spinal meningitis soon set in, and proved fatal by *opisthotonos*.

I ought to add that there are tumours which may be mistaken for spina bifida. I have seen a fatty tumour allowed to grow to an enormous size, under the idea that, being situated in the middle line of the spine, it was a spina bifida ; but this was only for want of careful examination. But congenital subcutaneous tumours, when situated exactly in the middle line, may lead to greater difficulties.² In almost all spina bifida tumours, however, the sac swells up when the child cries, and the edges of its aperture can be felt when it is flaccid. Some malformations are classed with spina bifida in which the whole spinal laminæ are deficient ; but they are of little practical interest, being incompatible with life.

¹ Wilson, in ‘*Path. Trans.*’ vol. xiv. p. 214. Several other cases have been since recorded. I may refer to two recently operated on at Leeds, and reported in the ‘*Brit. Med. Journ.*’ Dec. 30, 1882, p. 1297, by Mr. Robson, and April 14, 1883, p. 719, by Mr. Jessop. Also to a series of four cases operated on by Mr. Robson (‘*Clin. Soc. Trans.*’ vol. xviii. p. 216). In one of these the skin was separated from the spinal membranes and the latter sewn together separately from the skin and on a different line. Some rabbit’s periosteum was also implanted between the skin and the membranes ; but did not appear to produce any new bone to fill the cleft, as had been hoped. Success was obtained in three out of the four cases.

See T. Smith, in ‘*St. Bartholomew’s Hospital Reports,*’ vol. ii. p. 25.

CHAPTER XXV.

DISEASE OF MUSCLES AND BURSE.

Rupture of
muscles
and
tendons.

MUSCLES are liable to rupture from injury such as occurs not unfrequently in the pectoral muscle when a man in falling grasps at a bar and suddenly brings the whole momentum of his body to bear on the flaps of the axilla ; or from over-exertion, as is common in the gastrocnemius ;¹ or from spasm, as occurs sometimes in the rectus abdominus in cases of tetanus (see page 72). The usual seat of rupture is at the junction of the muscle and tendon, but it very commonly also takes place in the centre of the muscular belly, as is seen in the pectoralis major and the biceps flexor cubiti.² The diagnosis is easy when the accident is recent, from the hollow which replaces the natural outline of the muscle ; but when the injury is of some standing, and the seat of rupture has been filled up with the products of inflammation, it is very difficult to distinguish it from some form of innocent tumour.

The treatment consists in relaxing the muscle by some apparatus which will bring its two ends nearer together, and by careful and even bandaging, in order to push the muscular fibres downwards and diminish the gap. The prospects of ultimate recovery in the case of the gastrocnemius, which is the muscle most commonly the seat of this injury, are good. Hunter, we are told, 'did not confine himself to bed for this accident, but continued to walk about during the cure. His mode of treatment was to keep the heel raised, and to compress the muscle gently with a roller, by which any fresh separation of the ends of the tendon by spasmodic or involuntary contraction was prevented, for he found that by no *voluntary* impulse could he excite them to contract after the rupture of their tendon. . . . It was ascertained at Mr. Hunter's death that the union of the ruptured tendon was by ossific deposition.'

Severe sprain or rupture of some muscle, tendon, or ligament is of frequent occurrence in playing the fashionable game of lawn-tennis. Thus, slight swelling, with tenderness, over the pronator radii teres, with pain in bringing the muscle into action, is spoken of as the 'lawn-tennis arm,'³ and a rupture of the tendon of the plantaris muscle as the 'lawn-tennis leg' ; while a partial rupture of some of the ligaments of the knee, leading sometimes to general synovitis and prolonged lameness, is also not uncommon from over-exertion in this game. Of course, any of these injuries (especially the rupture of the plantaris tendon)⁴ may be met with from other causes.

Another not unfrequent injury of muscles is where the sheath is more or less torn and the muscle displaced to some extent from its bed—a lesion sometimes spoken of as 'dislocation' of the muscle. We meet not very uncommonly with the partial form of this injury ; but the complete, in which the

¹ John Hunter ruptured the tendo Achillis in dancing, at the age of forty.—Hunter's Works, vol. i. p. 34.

² In some cases it is probable that only the fascia covering the muscle may have been torn, allowing the fibres to protrude through the rent when the muscle acts, but not involving any actual lesion of the muscle itself.

³ See Morris, in 'Lancet,' July 29, 1882.

⁴ Judson, 'Lond. Med. Record,' 1881, p. 462.

whole belly of a muscle has been displaced, is far less common. The treatment consists in careful replacement as far as possible at the earliest moment after the injury (under anæsthesia if necessary), and careful position, bandaging, and rest for about a month.

This seems the best place to speak of an injury which is sometimes met with in other parts of the body, but much more commonly at the ankle than elsewhere—viz. dislocation of a tendon from its groove without injury to the tendon itself. The dislocation is either produced at once, or a previous sprain has somewhat loosened its connection with its sheath, and it gives way altogether in a second accident. The peroneus longus is far more commonly dislocated than any other tendon: but the peroneus brevis and the tibialis posterior have also been found to be displaced; and Sir J. Paget¹ alludes to three cases in his experience in which the extensor tendon of the middle finger has slipped over the heads of the metacarpal bone and first phalanx (an accident I have myself witnessed), as well as to a preparation in the Museum of St. Bartholomew's Hospital of the long tendon of the biceps dislocated from its groove. When the tendon is superficial, the signs of the injury are evident. The peroneus longus tendon, for instance, or the extensor tendon of the finger may be distinctly traced, and may be slipped back to its proper position, on relaxing the parts. Dislocation of the deeper tendons, such as that of the biceps, is probably (as Sir J. Paget believes) an injury whose precise nature could hardly be verified; and, in fact, there is still much controversy on the subject (see p. 277). When the nature of the case can be ascertained the tendon should be replaced, and confined in position by a pad or other appropriate apparatus; but it often remains loose for an indefinite time—at least, this seems to be the case with the peroneus longus. My patient, who had the extensor tendon of a finger displaced, soon completely recovered.²

Dislocation
of tendons.

Inflammation of muscles, as far as it can be distinguished from that of other parts, may be caused by injury, or occurs in the course of rheumatism. It frequently takes place in pyæmia, and then rapidly runs on to suppuration. The 'gummatous' tumours which form in the tertiary stage of constitutional syphilis may often be recognised in large muscular masses, such as the gastrocnemius or the scapular muscles, forming rounded, hard, movable tumours, which are painful, especially at night, and are very slow in their progress. They show very little tendency to suppurate. They are usually quickly removed by a course of iodide of potassium, perhaps assisted by iodine externally.

Inflamma-
tion of
muscles.

The sheaths of the long tendons of the forearm are often found inflamed after excessive exercise—as after a hard day's rowing—forming a long sausage-shaped swelling, inflamed and tender, and giving a peculiar creaking sensation to the finger when the muscle acts and sets in motion the lymph contained in its sheath ('ténosinite crépitante' of French authors). This inflammation usually subsides rapidly by rest and the application of iodine.

Inflamma-
tion of
tendons.
Teno-
synovitis.

¹ 'Clin. Lect. and Essays,' p. 86.

² A large number of cases and references bearing on this subject are collected in an interesting little pamphlet, entitled 'Surgical Cases read before the Boston Society for Medical Observation,' by Dr. H. H. A. Beach, Cambridge, U.S., 1876. See also a very interesting clinical lecture by Mr. Callender on Dislocations of Muscles, 'Brit. Med. Journ.' July 13, 1878.

Whitlow.

Whitlow is a popular name given to inflammation in or in the neighbourhood of the sheath of one of the flexor tendons of the fingers. Surgically speaking, however, there are various forms of this disease. The common whitlow, or paronychia, consists usually of a collection of purulent fluid between the skin and epidermis ('phlyzacious pustule,' as it is sometimes called), and requires nothing but the division of the epidermis and a little common dressing. In other cases abscess forms in the areolar tissue of the last phalanx, generally from the introduction of some septic material through a slight scratch. It is extremely painful, and should be early opened. This, however, involves no danger to the finger. But the acute inflammation inside the sheath of the tendon (paronychia tendinosa, or periosteal whitlow) is a very serious disease, and is too often, through the mismanagement of ignorant persons, permitted to go on to the destruction of the finger, or even of the hand. It arises usually after a punctured or poisoned wound, sometimes without known cause, as a deep-seated and very painful swelling, generally in the middle phalanx of the finger, with very little redness, and with a very slight amount of swelling compared to the pain, which is often so violent as to prevent the patient from sleeping. The part is exquisitely tender; it is too tense for fluctuation to be felt, but matter will almost certainly form in a very short time, and an incision is urgently needed, whether suppuration has or has not taken place. The relief to the pain and tension afforded by a free and deep incision in the middle line of the finger is decisive and immediate; and if the incision be made before the abscess has formed, so much the better for the integrity of the part. If, on the other hand, it is delayed, the inflammatory effusion will separate the tendon from the vessels which supply it, and cause sloughing of the tendon; or suppuration will penetrate the periosteum, producing necrosis of the phalanx, or may even burrow backwards into the palm of the hand and destroy the whole function of the member.¹

The incision is very painful, although the pain is only momentary, and therefore an anæsthetic may be given, especially as it renders it easier to incise the parts with the requisite freedom. The bleeding should be encouraged by putting the hand into warm water. Afterwards the hand should be elevated on to the opposite shoulder, and lint steeped in hot boracic lotion, under oil-silk, applied.

House-
maid's
knee.

The most common of all the diseases of bursæ is that enlargement of the bursa patellæ which is popularly called 'housemaid's knee,' inasmuch as women of this class are most liable to it, from the irritation of constant kneeling in their work. It is, however, by no means confined to housemaids, nor entirely to the female sex, though men are rarely the subjects of it. The disease is also sometimes caused by injury, with extravasation of blood into the bursa. In either case the effusion must be referred to inflammation, though frequently of so low a type that no inflammatory appearances are perceptible. It forms a prominent rounded tumour, covering the lower part of the patella, and in contact below with the capsule of the joint, usually too tense to allow of the feeling of fluctuation, though in other cases this may be perceptible. There is generally no pain or inconvenience at first, except the obstruction which the swelling causes to kneeling; but afterwards, from persistence in following the occupation, acute inflammation often comes on, with

Bursal
abscess.

¹ See two cases recorded by Mr. Tatum in 'Syst. of Surg.' 2nd ed. vol. iii. p. 548, in both of which amputation of the forearm became necessary.

great swelling, œdema, and redness extending around the joint, much pain, rigors, and other feverish symptoms. Such cases are occasionally mistaken for abscess in the joint; but the buried condition of the patella shows that the greater part at least of the abscess is external to the articulation; and though it is no doubt possible for a bursal abscess to make its way into the joint, yet it very rarely happens. Such abscesses should be early and pretty freely opened. It is a good plan to make an incision in front, then pass in a director and cut down on its point on either side of the cavity, so as to ensure a depending opening on either side. Bursal abscesses, as far as I have seen, almost always do well.

The ordinary chronic enlargement consists at first merely of the bursa, filled with a fluid much resembling synovia, and containing small portions

Bursitis, or
bursal en-
largement.

of fibrine; at other times more or less blood is mixed with the fluid. As disease progresses the walls of the bursa thicken, the portions of fibrine in the fluid increase, forming a number of 'millet-seed' bodies which can sometimes be felt creaking in the sac when it is handled. As the thickness of the walls increases the cavity becomes encroached upon—though the tumour may increase in size also—and sometimes the cyst is converted into a solid fibrous tumour. Far more commonly, however, a small cavity containing small lumps of fibrine or altered blood will be found at a very advanced period of the disease; and even when the tumour is solid throughout, its centre will be observed to be much softer and more succulent than its circumference (Fig. 242).



FIG. 242. Two bursal tumours, i.e. enlarged bursæ patellæ, which had become converted into cystic tumours by the development of an imperfect fibrous material in their walls, leaving only a cavity in their centre, with smaller alveolar interspaces in the fibrous tissue composing their walls. Their cavities were filled with partially decolourised blood. The enlargement had existed for about two years. The tumours were removed at the same operation from a woman aged 34, successfully. (St. George's Hospital Museum, Ser. iv. No. 14b.)

At its commencement the disease is very amenable to treatment. Perfect rest, with slight counter-irritation, as by tincture of iodine or a blister, repeated from time to time as may seem necessary, will remove the swelling: in fact, I have seen many of these bursæ subside altogether by simple confinement to bed. The objection to this plan of treatment is that the effusion often returns if the patient persists in kneeling. If the cyst is large but not thick, the fluid may be withdrawn by an aspirator and pressure applied with an indiarubber bandage. If, however, the walls of the bursa appear to be thick, or there is any evidence of lymph in the cavity, as denoted by a creaking sound on pressure, the most efficient plan is to treat the case by incision, turn out any melon-seed bodies or masses of lymph which may be contained in it, insert a drainage-tube for a day or two, and dress antiseptically. When the walls are much thickened, the total removal of the tumour is the most advisable course. The surgeon will remember that the lower part of the tumour is in contact with the capsule of the joint. A free incision is to be made from top to bottom over the middle line of the tumour and the skin fully dissected back on both sides. Then the upper portion of the tumour is separated

from the periosteum of the patella, and in removing the lower part from the capsule of the joint care is taken to put on the stretch the cellular adhesions which fix it, and divide them, with the edge of the knife turned *towards* the tumour. In this way it is impossible to wound the joint. The wound is to be strapped up carefully, and the limb put on a splint and carefully bandaged from the foot upwards.

Affections
of various
bursæ.

Numerous other bursæ exist in the normal condition, or are developed from constant friction between the skin and an underlying bone. There is one on the anterior aspect of the upper end of the tibia, between the tubercle of the tibia and the ligamentum patellæ, which is occasionally, though rarely, found enlarged; one over the olecranon, which is peculiarly apt to enlarge in miners, from the attitude in which they constantly work, and is therefore denominated 'miner's elbow'; and several in the popliteal space,¹ one

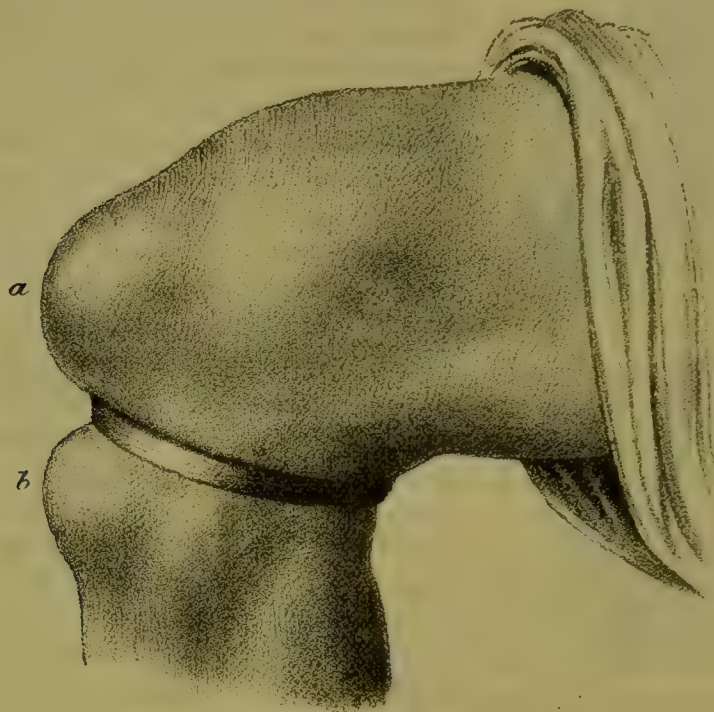


FIG. 243. Sketch of a knee affected with two bursal tumours. The upper one (a) the ordinary patella bursa, the lower, (b) over the tubercle of the tibia. A band has been tied between them.—From a drawing by Mr. H. Higgins.

of which, that beneath the tendon of the semi-membranosus muscle, is comparatively often enlarged, and when it shares the pulsation of the popliteal artery has been mistaken for aneurism, though such a mistake can only be accounted for by carelessness. The bursa under the tendon of the psoas is another instance in which a natural bursa is occasionally enlarged. The subject has been treated of in reference to the diagnosis of hip-disease on p. 497. None of these bursal enlargements (if we except the last) are difficult of diagnosis to one who remembers their position and the fact of their occasional diseased condition. But if any hesitation is felt as to the nature of the tumour the grooved needle will solve the difficulty at once. These enlarged bursæ must be treated in the same way as housemaid's knee, by blisters, iodine injection, or incision. And if they suppurate, as some are very prone to do, especially that over the olecranon, they should be laid pretty freely open. Suppuration in this bursa often produces a diffused inflammation extending

¹ For an account of the normal anatomy of these bursæ see Gray's 'Anatomy,' 11th ed. p. 541.

down the forearm, which is sometimes mistaken for phlegmonous erysipelas, but which really requires no treatment beyond the free evacuation of the bursal abscess.

In treating the bursæ which are comparatively often found in the popliteal space the surgeon must remember that those at the outer side of the ham almost always communicate with the joint, and that beneath the tendon of the semi-membranosus not unfrequently does so. Great care, therefore, is necessary to examine the limb in various positions, in order to ascertain whether this is the case before any active treatment is undertaken. The communication, if it exists, can generally be opened by flexing the knee, and then some or all of the fluid in the bursa can be pressed back into the joint. When this is the case no operation is admissible. When the bursa does not appear to communicate with the joint, if the patient suffers much inconvenience from the presence of the tumour, and external applications with rest have failed to cure it, it will be justifiable to inject it with iodine, or to put a fine seton through it.¹ But such bursæ often exist, and attain a large size, without giving the patient any trouble. I saw a man once who had been for more than ten years an able seaman in Her Majesty's Navy, and who had never suffered in the least from the presence of the bursa, though it was unusually large.

Bursæ of new formation are found over the displaced bones in clubfoot, over the end of the fibula in tailors, and in many parts of the body subject to pressure; and accidental or irregular bursæ are met with in various parts—e.g. over the hyoid bone or larynx—but they seldom grow to a size requiring any serious treatment.

A bunion is a bursa formed over the half-dislocated phalanx of the great toe from the pressure of the boot. It is often followed by destructive disease of the joint. But it does not always (at least at first) communicate with it. When the affection is confined to mere inflammation of the bursa, rest and soothing applications will probably subdue it, and its recurrence must be obviated by some change in the shape of the boot. If it suppurates it is better to allow it to burst without interference; but if the matter will not come to the surface it must be incised, and then if it does not seem to communicate with the joint its interior may be rubbed with lunar caustic or the strong nitric acid, in order to procure its obliteration. If the joint is involved, the shortest and, on the whole, the best course for the patient is to amputate the toe, though if the patient wishes it there is no objection to the resection of the diseased joint. It is doubtful, however, whether this operation, even if successful, will leave the foot more useful than after amputation of the toe.² Bunion.

Ganglion is the name given to an enlarged bursa which is developed in connection with one of the tendons. Such bursæ are most common on the back of the wrist, on or near the extensor secundi internodii pollicis, though they are not rarely developed in other tendons. The exact connection of the sac with the tendon does not seem to be quite clearly ascertained. It forms a small, hard, round swelling at the back of the joint, and the main symptom Ganglion.

¹ On the frequent connection between such bursæ and the joint, see p. 473.

² I am speaking of cases of old semi-dislocation with inflamed bunion, where the bones are often much altered in shape, and the tendons rigid. In ordinary disease of the metatarso-phalangeal joint, there is no doubt that excision leaves a most useful foot.

which it causes is weakness of the wrist and hand, sometimes to an extent which is hard to reconcile with the apparent triviality of the affection. It has been clearly proved that, in some cases at any rate, a ganglion owes its origin to a protrusion of the synovial membrane of the wrist or carpal joints,¹ and this is probably often, if not always, the nature of those ganglia which present deep in the wrist under or close to the radial artery; but that the more superficial and movable ones are formed in the same way is at any rate unproved. Nor is it proved, or probable, that as a rule they have any open communication with the sheaths of the tendons, though they are believed to be often developed by an outgrowth from them originally, the communication between it and the sheath of the tendons having become obliterated.

A ganglion almost always contains a clear gelatinous fluid exactly resembling thin jelly.

The treatment consists in freely dividing the ganglion subcutaneously, squeezing out the contents, and applying pressure. The old rough method of bursting the sac by the blow of a book or by forcible pressure was essentially the same, but it is far less certain, more painful, and is, besides, excessively rough and unsurgical. It is far better to pass in a tendon-knife at a little distance from the small round lump, apply its edge fairly to the side of the tumour, and cut the sac across as freely as possible. Then all the contents of the sac are to be squeezed out—whether through the puncture or into the cellular tissue does not matter—and pressure is to be applied by means of a piece of sheet-lead, or other firm substance, carefully strapped on to the remains of the sac. This method succeeds in the great majority of cases, but in some the tumour refills even after it has been subcutaneously divided with all possible care many times. Such cases may usually be cured by a seton of two or three threads run through the sac, and kept in till suppuration is set up, when it can be withdrawn. If this also fails, the choice is between laying the ganglion open and dressing in the cavity till it fills up, or dissecting it out. The former plan is the one which I prefer. It is, I believe, almost always successful, and with antiseptic precautions involves very little danger. The sac should be carefully emptied of its contents, and it will sometimes be found that the failure of the previous treatment was due to the presence of millet-seed bodies in the sac.

Compound
palmar
ganglion.

The compound palmar ganglion is a tumour or cyst developed in the sheath of the common flexor tendons passing under the annular ligament of the wrist. It forms a tumour which presents in the forearm and in the palm, extending on both sides of the annular ligament which binds down its central part; and often, on making the patient move his fingers, a creaking sensation is perceived, caused by the 'millet-seed' bodies which are found in it. These are small masses of lymph, often very numerous, which are almost always contained in these compound ganglions. The wrist is very much limited in its movements in these cases, and some of the fingers also are sometimes entirely deprived of motion, flexed into the palm, and utterly useless. The main obstacle to the cure of the disease is the presence of the millet-seed bodies; when these are evacuated the case generally does well. I have never hitherto seen a case of this disease in which any progress to cure was made until these bodies had been evacuated, and I have now given up as useless any attempts to cure it by blisters or injections. The best plan is to make a limited incision into one part of the tumour (that in the forearm is usually

¹ There is a preparation in the Museum of St. George's Hospital showing such a communication in a case of ganglion. See also Nélaton, 'Path. Chir.' vol. v. p. 905.

selected), and press out all the millet-seed bodies, emptying the sac as completely as possible. Strapping should be applied methodically from below upwards, so as to keep the parietes of the sac as closely in contact as possible, in the hope that they will close and that no further inflammation will occur. Effectual drainage must be provided for, the limb must be secured on a splint, and the dressing carefully carried out.

Muscles are subject to various degenerations, some of which constitute definite and important surgical affections; others are rather the consequences or accompaniments of disease, or are mere pathological curiosities. The atrophy which follows on disuse requires no further notice—the muscle is merely smaller, but without any change in the anatomical structure of its fibres. Clearly contrasted with this is the ‘progressive muscular atrophy’ of Cruveilhier, in which, from some general cause which is not at present completely understood, the muscular tissue in one or more regions becomes, without any known injury or other reason, wasted—the wasting extends during an indefinite period, involves fresh groups of muscles, and may go on till the patient’s death. The disease is often hereditary, and it affects usually the male members of the family. In other cases it has been thought to be excited by cold and damp, or by syphilis. Cruveilhier believed that the disease depended on degeneration of the anterior or motor roots of the spinal nerves; but this seems contradicted by the result of post-mortem examination in many cases where no such lesion existed. Dr. Lockhart Clarke believes that the essence of the disease consists in ‘lesions of the grey substance of the cord,’ consisting chiefly of areas of what he calls ‘granular and fluid disintegration’; and other pathologists have supported this statement,¹ which is rendered still more probable by the fact that symptoms identical with the hereditary affection have been noted in cases of obvious disease of the spinal cord. It is probable, therefore, that the disease should be classed with those of the nervous centres; yet, as this is not yet absolutely proved, it is generally still assigned to those of the muscles. It commences most commonly in the upper extremity, and usually with wasting of the muscles of the palm, spreading upwards to those of the arm, chest, abdomen, and, lastly, to those of respiration and deglutition. More rarely it begins in the thorax, and still more rarely in the lower limbs. The weakness is accompanied by a loss of co-ordination, producing uncertainty in the movements, with cramps and twitches in the part. Sensation is usually unaffected. Occasionally there is some numbness, and pain is complained of in the affected muscles in about half the cases. The wasting does not involve the whole muscle. On microscopic examination, side by side with the wasted fibres are seen others which are perfectly natural, and the same is the case to the naked eye. The atrophy is accompanied by granular or fatty degeneration of the muscular tissue, the sarcous elements being replaced by granules or fat-cells, while the striæ have become more or less indistinct. In other cases a rarer degeneration is found—the *waxy* or *vitreous*—in which the fibres are changed into a transparent homogeneous substance, in which no striæ can be seen, and the muscle resembles a piece of tendon or aponeurosis.

The treatment of this disease is rarely satisfactory. Strict attention to the general health, the treatment of any syphilitic taint which may be present or be suspected, the prolonged use of galvanism in its various forms, and

Degenerations of muscle. Simple atrophy.

Progressive muscular atrophy.

¹ See Charcot, ‘Lectures on Diseases of the Nervous System,’ New Syd. Soc. Trans. lect. iii.

the use of the warm sulphurous water of Aix-la-Chapelle, appear to be of admitted value. Medical treatment may succeed in some cases, and if so the drugs which are most likely to be of value are arsenic, phosphorus, and the mineral tonics, as zinc or iron. But to be efficacious these remedies must be long continued, in small doses. Dr. Lockhart Clarke suggests the trial of counter-irritation to the spine.

Besides these two well-marked forms of atrophy there are others in which the atrophy of disuse is variously combined with fatty or granular degeneration 'in acute diseases, alcoholism, lead-poisoning, rheumatism,' &c. ; but as this is merely a subordinate feature of the general disease, nothing further need be said about it.¹

Infantile
paralysis.

Two forms of degeneration of muscles in childhood claim notice here. 1. Infantile paralysis, or 'essential' paralysis, so called because it is not supposed to be connected with any morbid state of the nervous centres. We may fairly reserve our opinion on the latter point. No proof has, it is true, been obtained hitherto that the spinal cord is affected in infantile paralysis ;² yet the symptoms point strongly to disease either of the cord or nerves as the cause of the paralysis which so speedily occurs in a muscle or group of muscles. The disease begins usually after a feverish attack, or sometimes during teething, after convulsions, and in some cases without any noticeable derangement of the general health. The muscular affection, whether preceded by general ill-health or not, is in itself sudden. It usually affects the lower extremities, and either the whole limb or groups of its muscles, or a solitary muscle may be affected. Less commonly it is noticed in the upper extremity. The muscle which is most commonly affected alone is, I think, the deltoid. The sternomastoid is also sometimes alone affected. When special groups of muscles of the leg are paralysed the corresponding form of clubfoot follows from the unbalanced action of their antagonists. Paralysis affecting the muscles of one buttock sometimes leads to a suspicion of hip-disease, but is easily distinguished from it on attentive examination, by the perfect freedom and painlessness of passive motion.

When the disease is inveterate nothing can be done except to restore the limbs by tenotomy and mechanical appliances to such a position as may be most useful to the patient, if he has the power of using them in any degree. But in early cases a cure may fairly be hoped for from the persistent use of galvanism, from exciting the muscles to voluntary action as far as is possible,³ from tonics, such as strychnia, and from shampooing or rubbing the limbs.

2. The other form of paralysis in childhood is that curious disease called 'pseudo-hypertrophic paralysis,' or 'Duchenne's disease.' The subjects are as a rule more or less idiotic. After a stage of partial paralysis, or weakness of the lower limbs, which may last several months, the patient being quite unable to stand or walk, the stage of hypertrophy commences, in which the gastrocnemii, the gluteal muscles, and those of the loins become very much

¹ I do not speak here of 'locomotor ataxy,' regarding it as lying more in the province of a treatise on medicine ; and I apply the same observation to trichiniasis.

² Charcot, however, has recently taught, as the result of his own researches and those of other eminent pathologists, that there is in this disease atrophy of the motor cells in that portion of the cord from which the affected parts derive their nerves. See Charcot, 'Lectures on Diseases of the Nervous System,' New Syd. Soc. Trans. p. 57.

³ Much good often results from putting the child in a 'go-cart,' where, in order to move about, the affected muscles must be called upon to act.

swollen. The swelling, however, or apparent hypertrophy, is found to be due not to any real hypertrophy of the muscle, but to an abundant formation of connective-tissue or fat, or both, amongst its fibres, which are themselves, at least at first, healthy and present the normal response to galvanism. In the third stage (which may be deferred for years after the commencement of the second) the limbs begin to waste, complete paralysis ensues, and the patient dies sooner or later, unless some accidental malady carries him off.

‘During its first stage the disease is sometimes curable. Duchenne has recorded two such cases.¹ But in the second stage scarcely any hope of recovery can be entertained. The treatment consists chiefly of local faradization and shampooing.’—Lockhart Clarke.

Muscles are subject to all the forms of tumour described in Chap. XVII., but I do not know that their occurrence in muscles is a fact of any special significance. I have spoken on p. 357 of the singular cases in which muscles ossify, or where loose bony tumours are found to be developed in them. The gummatous tumours due to syphilis sometimes attain an enormous size, and in one well-known case² the scapula was removed for such a growth. They are, however, almost always amenable to internal remedies.

Tumours of
muscle.

¹ ‘De la Paralyse musculaire pseudo-hypertrophique.’ Paris, 1868.

² South, in ‘Path. Trans.’ vol. vii. p. 346.

CHAPTER XXVI.

CLUBFOOT AND OTHER DEFORMITIES.—ORTHOPÆDIC SURGERY.

THE various deformities which are treated of in this chapter, and of which clubfoot may be taken as the type, as it is also by far the most frequent example, are due to shortening of the muscles, the result either of the relaxation of their antagonists from paralysis, of a tonic spasm in their own substance, or of some change in the structure of the muscular fibres, leading to their permanent contraction.¹ It is very difficult, indeed, to determine the share which paralysis or spasm respectively may have in producing the congenital forms of the malady, but in many of the non-congenital cases the deformity clearly depends on infantile paralysis. Congenital cases, on the other hand, seem more of a spasmodic nature, though the spasm relaxes to a great extent in sleep or in yawning,² and they are accordingly generally believed to depend on some abnormal state of the nervous centres, though what that state is remains unknown. A very interesting article by Messrs. Parker and Shattock³ on the etiology of clubfoot refers the deformity to mechanical causes, i.e. to pressure in intra-uterine life (probably connected with variations in the quantity of the liquor amnii), whereby the position natural to the feet at certain periods is exaggerated. As the feet are naturally inverted at an early period pressure commencing at that time would produce *T. varus*; whilst the exaggeration of the flexed position which the feet assume in later uterine life would produce *T. calcaneus*. The cases in which deformity is produced by disease of the muscles themselves, irrespective of spasmodic or paralytic deformity, are purely exceptional. The main point to determine in the treatment of deformities is their curability by or without surgical operation. The milder cases of deformity, whether spastic or paralytic, may be remedied by gradual extension by means of appropriate apparatus, and some even by the manipulations of the nurse or mother; but for cases of ordinary severity tenotomy is required before the application of the instrument intended to place the parts in the natural position.

Tenotomy.

Tenotomy, or the subcutaneous division of tendons, is an operation now very extensively practised, but for which the surgical profession is indebted to the genius of a surgeon lately deceased—the illustrious Stromeyer.⁴ It

¹ This change is called by American surgeons ‘contracture,’ and is chiefly exemplified by the state of the muscles on the flexed side of a permanently contracted joint, as the hip or knee.

² See Dr. Little’s observations on this head in ‘Syst. of Surg.’ 3rd ed. vol. ii. pp. 227 et seq.

³ ‘Path. Soc. Trans.’ vol. xxxv. p. 423.

⁴ Dr. Adams says: ‘On Feb. 28, 1831, Stromeyer first divided the tendo Achillis by subcutaneous puncture in a case of non-congenital equinovarus in a boy aged nineteen. No inflammation followed. By gradual extension the deformity was cured in two months, and the boy allowed to walk with a steel support to the boot.’—‘Rust’s Magazine,’ 1833, vol. xxxix. p. 195. But though Stromeyer’s priority in the practical use of tenotomy is undisputed, the priority in the suggestion is due to Delpach, as Stromeyer has expressly pointed out. John Hunter, after he had suffered in his own person from rupture of the tendo Achillis (see p. 524), investigated the process of union after subcutaneous division of the tendo Achillis in dogs, and his preparations are still in the Museum of the College

consists in passing a small thin knife through a minute puncture close to the contracted tendon; dividing it, if possible, without injuring any part in its vicinity; then withdrawing the knife, closing the wound carefully and allowing it to heal, which in almost all cases it does by the process of first intention. The upper end of the divided tendon retracts in its sheath, and the sheath becomes filled with lymph, in which fibrous tissue is developed, very much as a simple fracture is united. This fibrous tissue is at first soft, and easily yields to an extending force (Fig. 244); and the subsequent treatment consists in gently drawing it out to the required length. Many surgeons now adopt the plan of bringing the part into its natural position at once, and do not wait for the divided ends of the tendon to unite before applying any extending force.

The result of this is that a wide gap is left between the cut ends of the tendon, which has to be filled up by the development of new tissue. Experience seems to prove that this is usually accomplished; and the plan certainly possesses this advantage, that all extending apparatus, which are at the same time expensive and cumbersome, are done away with and the



FIG. 244. A specimen showing the condition of the tendo Achillis in an adult 22 days after its division. The operation had been performed in order to assist in the reduction of a compound fracture of the leg. Amputation became necessary at the above period.—From St. George's Hospital Museum, Ser. iv. No. 20.



FIG. 245. An eye, showing the union of the tendon of the external rectus muscle after its division in a case of squint. The patient died of phthisis a month after the operation. The muscle (which is seen at the upper part of the figure) is now connected to the sclerotic by a long thin bundle of fibrous tissue. The insertion of the original tendon into the tunica albuginea is perfectly distinct, and appears quite separate from the new uniting material. The latter was so firm that it allowed of forcible traction without giving way. The deformity appeared to be cured.—St. George's Hospital Museum, Ser. iv. No. 7.

part placed at once in its natural position in a casing of plaster of Paris, in which it can be allowed to remain until the process of union of the divided tendon is accomplished. When this process is completed the uniting material is thinner than the natural tendon, and the muscle comparatively weak; but it gradually acquires strength and breadth, and when examined some time afterwards so closely resembles the original tendon¹ that the difference is only

of Surgeons. He came to the perfectly correct conclusion that the process 'was similar to that of fractured bones where the skin is not wounded.' In fact, Hunter may, as Mr. Adams has said, be regarded as the originator of subcutaneous surgery.

¹ The process of union in divided tendons has been most minutely described by Mr. W. Adams, 'On the Reparative Process in Human Tendons after Division.' I would refer the reader to the 4th chapter of that work for many details for which space fails me here.

visible on a fresh section, and after very close examination. Sometimes after division one or both ends of the divided tendon may adhere to a neighbouring bone and the function of the divided muscle may thus be lost, at any rate for the time. Still, it seems that these adhesions often give way ultimately and the muscle resumes its functions; and even if not, the limb will probably be very useful. The tendo Achillis, which is the most important of the tendons usually divided, lies too far away from the tibia to be subject to this accident.

In other cases, the tendon, if divided near its insertion, may form for itself an entirely new attachment, as was the case in the instance from which Fig. 245 was taken. But in such a case the operation will probably be as successful as if the two ends of the tendon had been united in the ordinary way.

I mention these irregularities in the method of union inasmuch as they have been made the ground for decrying the operation of tenotomy altogether, except as applied to the tendo Achillis, and for substituting extension for it as the general method of treating clubfoot.¹ Mr. Barwell is impressed with the belief that after the division of the tibialis posticus and other deeply seated tendons the tendon often does not unite in its natural relations, and that a lameness is left—‘less apparent, perhaps, but certainly more incurable than the original disease.’ I can only say that after the appearance of Mr. Barwell’s paper I have carefully examined many cases, under my own and other surgeons’ care, in which these tendons have been divided, and have failed to verify Mr. Barwell’s statement. The foot, in favourable cases, is very nearly natural. Beyond some flattening of the arch and widening of the sole, there is little change in its external appearance, and the patient walks nimbly and with no perceptible limp. Nor is Mr. Barwell’s method of extension, by means of indiarubber cords hooked on to splints which are kept in place by plaster, at all easy to apply successfully in cases where the deformity is serious, since the traction necessary to correct the deformity will either pull the splints off, or, if they are more securely fastened by the strapping, the latter will then cut into the skin. My own trials of this method have consequently been disappointing; yet its principle, that of substituting gradually increasing elastic tension for the muscles which are paralysed, is so obviously sound for the treatment of paralytic deformity, that I thought it right to direct the reader’s attention to it. I consider it a valuable method of treatment in the slighter cases of paralytic deformity; though Mr. Barwell’s statement of the evils attending tenotomy seems overdrawn, and tenotomy is still in general use in all ordinary cases.

Tenotomy is generally employed in the cure of clubfoot; sometimes, as in the case from which Fig. 244 was drawn, to facilitate the reduction of a fractured bone, sometimes of a dislocation; also for squint and wry-neck, and in various deformities, as those produced by diseased hip, knee, &c. Muscles also are occasionally divided, either subcutaneously or otherwise, in plastic operations, as the levator palati molliis in staphyloraphy. In all these cases the object of the surgeon is to divide the tendon or muscle as cleanly and with as small a wound as possible; and, if the operation be subcutaneous, to keep the parts quiet until primary union is ensured. Recently it has been proposed in cases of deformity of paralytic origin to excise portions of muscles and

¹ Barwell, ‘On certain Grave Evils attending Tenotomy, and on a New Method of Curing Deformities of the Foot.’—‘Med.-Chir. Trans.’ vol. xlv. p. 25.

tendons for its relief.¹ The operation has been principally applied in cases of paralytic *T. calcaneus* by excising from half to three-quarters of an inch of the tendo Achillis. The ends of the tendon are cut obliquely in opposite directions; so that when approximated they overlap splice-wise and are sutured in this position by (preferably) some absorbable material. The operation is to be conducted on antiseptic principles and the foot secured in a position of extension by appropriate splints. The operation, of course, is not applicable in those cases where the muscle has undergone complete degeneration.

I now turn to the various kinds of clubfoot.

Talipes equinus is the deformity produced by a contracted state of the gastrocnemius muscle, drawing the os calcis directly upwards, and causing the patient to walk on the metatarso-phalangeal joints and the toes, the foot bearing a strong resemblance to that of a horse, whence the name. Figs. 246, 247, taken from an old neglected case of this deformity, will give a better

Talipes
equinus.



FIG. 246. A preparation of talipes equinus seen from the inner side. *a*, tibialis anticus; *b*, extensor proprius pollicis; *c*, extensor longus digitorum; *d*, skin, with contracted plantar fascia; *e*, tibialis posticus; *f*, tendo Achillis; *h*, tendon of flexor longus pollicis; *k*, flexor longus digitorum.



FIG. 247. The same preparation seen from the outer side. *a*, tibialis anticus; *b*, extensor proprius pollicis; *c*, extensor longus digitorum; *d*, flexor brevis digitorum; *e*, plantar fascia; *f*, tendo Achillis; *g*, *h*, peroneus brevis and longus; *i*, peroneus tertius.—From a preparation in St. George's Hospital Museum, Ser. iv. No. 22.

idea of its anatomy than words can do. It will be seen that the heel-bone is drawn into a tolerably vertical position; the tarsus is much curved forwards, so that the metatarsus approaches the os calcis; and the muscles of the sole of the foot, with the plantar fascia, are very much contracted, the long muscles in front proportionally stretched, those on the inner and outer aspects of the foot not materially affected.

The cure of the deformity is to be sought in the elongation of the contracted gastrocnemius muscle. In very slight incipient cases this might perhaps be done by repeated manipulations and by the gradual traction of a splint

¹ 'Brit. Med. Journ,' May 31, 1884, p. 1058. See also four cases recorded by Mr Walsham, *ibid.* vol. i. 1884, p. 1147.

of ductile metal applied in front, the angle being carefully changed till the foot is drawn up to and beyond a right angle.

Division of
the tendo
Achillis.

Tenotomy offers a ready means of restoring the position of the foot, and experience proves that the muscle after its elongation may recover its functions sufficiently for all the purposes of ordinary life. So that if the deformity is at all strongly pronounced—that is, if the foot cannot be brought to a right angle, or on being released flies strongly back—it seems of little use to waste time on less effectual treatment. The tendo Achillis should be divided by turning the child on its belly and introducing the tenotome on the inner side below and as close to the tendon as possible, a short distance above the point of its attachment, where it seems thinnest, the foot being still extended. When the knife is fairly under the tendon the foot is to be strongly flexed by the assistant, while the surgeon, with a slight sawing motion, presses the knife's edge against the tightened tendon. As soon as it has been sufficiently divided the extending force will rupture it with an audible snap, when the knife should be instantly turned flat so that the skin may not be cut, and should be withdrawn. If the operation has been dexterously performed hardly a drop of blood will escape. The wound should be covered with a small piece of cotton-wool dipped in collodion, and bandaged. Two courses may now be followed: either the foot may be at once brought into its normal position and put up in plaster of Paris,¹ or the foot may be placed on a splint in the extended position in which it was found before the operation, and no attempt made to bring it to the natural angle till the wound is healed. Scarpa's shoe is then to be applied, in order to stretch the uniting material and elongate the muscle to the extent necessary to bring the sole of the foot flat to the ground. When this is done (which in a favourable case may be in about two months) a boot with irons is to be applied to prevent re-contraction, and if the child is old enough he may be allowed to walk. In complicated cases the division of the plantar fascia, and possibly of some of the muscles of the sole, is necessary in order to unfold the tarsus, as will be sufficiently seen from Figs. 246, 247.

Talipes
varus.

The severer forms of talipes equinus, such as that represented above, are commonly congenital; and, as Dr. Little has observed, such cases of congenital equinus usually remain throughout life purely equinus—i.e. the foot is perfectly straight, without any material deviation to the inside or the outside. But the common form of congenital clubfoot is talipes varus, or equinovarus. In the pure T. varus the os calcis would be on the same horizontal level as the metatarsus; but if this is ever the case it must be very rare. In practice the os calcis is always found more or less elevated—i.e. the case partakes more or less of the essential characters of T. equinus. The term T. varus is usually applied to those in which the heel is not very much elevated; when it is so the deformity is named T. equinovarus; but in ordinary nomenclature they may be regarded as synonymous.

The deformity consists in a simultaneous contraction of the tendo Achillis and the tendon of the tibialis posticus, that of the tibialis anticus being also almost always contracted, and very often the flexor longus digitorum as

¹ Mr. Marsh recommends removing the deformity in two or three stages. After the division of the tendon, about a third of the deformity is at once corrected and the foot enclosed in plaster of Paris; at the end of a week another third of the deformity is removed and the foot put up again; and at the end of another week the foot is placed in the completely normal position, enclosed in plaster, and left for three weeks.—'Lancet,' vol. i. 1888, p. 313.

well. The internal portion of the plantar fascia is also constantly found contracted; and this, if the deformity is inveterate, involves also the contraction of one or more, or all, of the short muscles of the sole.

The deformity of course increases the longer it is neglected. When the child begins to walk he rests on the outer side and partly on the dorsum of the foot, on which part large bursæ usually form. If the skeleton of the foot be examined (Fig. 249) in a case of old deformity, the ankle-joint will be found distorted, the fibula being drawn behind the tibia, the internal malleolus almost or quite in contact with the scaphoid bone, the astragalus pushed out towards the outer side of the dorsum, the cuboid bone turned downwards, so that its dorsal face supports the arch of the tarsus; the metatarsus, which is curved towards the calcaneum, is more or less vertical instead of horizontal. In old cases all the bones are changed in shape, and the ligaments, muscles, and fasciæ have also undergone corresponding changes. Such cases are, of course, incurable; or, if the position of the foot is to be remedied at all, it can only be so by excising some of the deformed

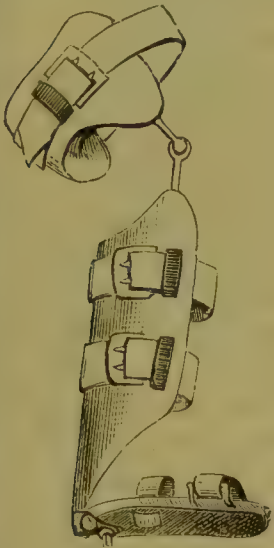


FIG. 248. Shoe for the treatment of simple talipes equinus in infancy.—From Holmes's 'Surg. Treat. of Children's Diseases.'

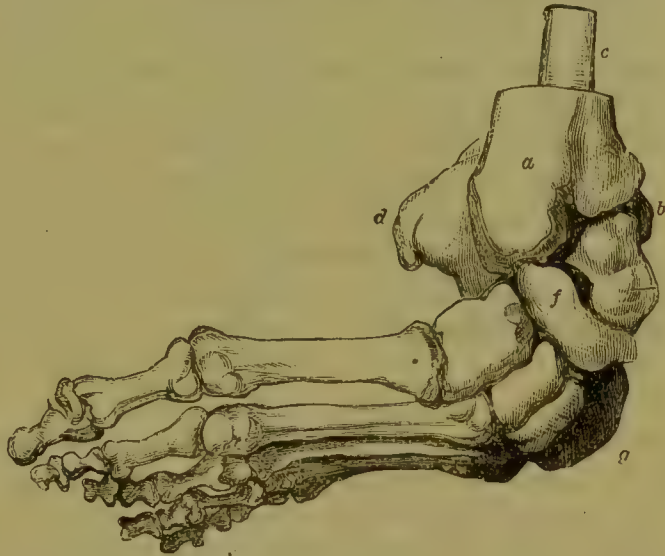


FIG. 249. Severe adult congenital varus, viewed from the front and inside; *a*, the tibia, cut down, in order to show the relatively posterior situation of the fibula; *b*, the external malleolus; *c*, the fibula; *d*, the posterior extremity of the os calcis drawn abnormally inwards; *e*, the astragalus unduly prominent on the dorsum of the foot; *f*, the navicular bone in contact with the internal malleolus; *g*, the cuboid, its posterior surface applied to the ground.—From Little, in 'Syst. of Surg.' vol. ii. p. 231, 3rd. ed.

bones. But in early life, while the structures are yielding and the parts have not undergone any irremediable change, a very useful foot indeed may be obtained. In all the cases of cure which I have seen, a certain degree of flattening of the sole remained, and the patient, if severely tested, would not have been able to run, hop, or leap from a height with the same force or security as one who had the natural arch and spring of the foot; but for ordinary locomotion there is often little to be desired.

The treatment by manual extension or by india-rubber bands or other mechanism may succeed in the slighter cases, but for cases of ordinary severity the section of the tendo Achillis and that of the two tibial tendons is commonly necessary. Very often, also, the plantar fascia and the muscles in the sole of the foot will require division.¹ Many surgeons prefer to divide the

¹ Dr. Geo. Buchanan, of Glasgow, has called attention to the necessity in many cases of clubfoot for a deep incision in the sole of the foot in order to unfold the contracted tarsus and metatarsus (see his 'Address in Clinical Surgery,' 1874, p. 24). A glance at Fig. 246 will show how the plantar muscles are contracted in these cases.

Division of
the tibial
tendons.

tibial tendons first, and to convert the deformity into one of simple equinus before dividing the tendo Achillis; and this is, no doubt, the better plan in the graver cases of the deformity, since the heel forms a firmer *point d'appui* for the instrument than if the great tendon has been divided. The operation of dividing the tendon of the tibialis posticus in a fat baby is not always an easy one, and several cases have occurred in which, the child having accidentally died soon after the supposed tenotomy, it has been proved by dissection that the tendon had been missed. The small size of the tendon and the depth at which it lies buried account for these mistakes. Another danger is that of wounding the posterior tibial artery, which lies close to the tendon in the leg. For this reason, apparently, some surgeons have practised the division of the tendon in the tarsus; but in the infant it is very difficult indeed to find it there. The sharp tenotomy-knife is to be introduced close to the posterior edge of the tibia,¹ about an inch above the ankle; and the fascia having been freely opened (including the sheath of the muscles), a blunt-pointed tenotome is substituted for it, and its edge turned towards the tendon. An assistant holds the foot inverted during this stage of the operation. Then he forcibly everts the foot, and as the operator raises his knife the tendon is felt to yield. If the operator believes that he has missed the tendon he must re-introduce his knife close to the bone, pass it somewhat more deeply, and repeat the previous manœuvres. It is very difficult in relapsed cases, where the tendon has been previously divided, to be sure whether it has been severed or not. The assistant often feels the snap of the divided tendon more plainly than the surgeon. If profuse bleeding and blanching of the foot testify to a wound of the posterior tibial artery, careful graduated pressure should be made on the wound, and the limb be neatly and firmly bandaged (but not too tight) from the toes upwards on a splint; and no extension should be made for at least a fortnight. The accident is believed to happen very often, but in only one case was it ever thought necessary to tie the artery afterwards, and then, it is believed, only in consequence of extension having been used too soon. The flexor longus digitorum is often divided at the same time as the tibialis posticus, either accidentally or purposely. Much has been said about the risk of loss of motion afterwards in consequence of the adhesion of the divided ends of the tibialis posticus tendon to its sheath or to the bone; but Mr. Adams's dissections² have shown that such adhesion is not very common, and that when it occurs it does not by any means necessarily involve the loss of the action of the muscle, since the adhesion often stretches to an extent which allows the muscle considerable play; and I may add that I have examined patients in whom the action of this muscle seemed to have been lost, yet who had very useful feet. The tibialis anticus tendon is easily divided, as it passes in front of the ankle, by merely inserting the knife flat beneath it, and turning its edge towards the tendon, while the assistant manipulates the foot suitably to the convenience of the operator. The tendon is displaced inwards by the adduction of the foot, and the artery and nerve are quite out of danger.

No special directions are required for dividing the contracted fascia and muscles in the sole.

Numerous apparatus for the treatment of varus are in use, but space

¹ If the edge of the tibia cannot be felt with the finger, the knife is to be inserted about midway between the anterior and posterior borders of the leg, and the bone is to be felt with the point of the knife.

² 'Path. Trans.' vol. xxi. p. 417, and vol. xxiii. p. 308.

forbids me to dwell with any minuteness on the subject. I append a representation of one which seems to me as useful and as little cumbrous as any, and which will illustrate the general principles on which they are constructed. The heel being carefully kept in the hole made for it in the

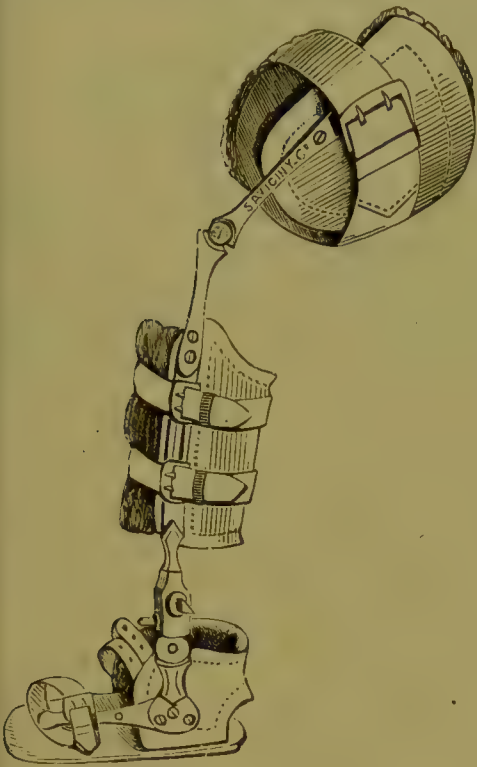


FIG. 250. Shoe for varus.—Holmes's 'Surg. Treat. of Children's Diseases.'

back of the footpiece, the foot is to be secured in the latter, the sole of the footpiece being applied to the foot, not the foot forced on to the sole. It is kept in position by straps over the ankle and toes, as seen in the figure. Then the leg and thigh are secured, and the instrument is in position. The joint at the knee is made free, so that the leg-and-footpiece may be the less liable to displacement. One of the screws changes the angle of inclination of the sole to the horizon, and the other regulates the inclination of the axis of the foot to that of the leg, the former correcting the tendency to varus, the latter that to equinus. The great point in the successful management of cases of clubfoot is, after the complete division of the affected tendons, to manage the instruments with so much gentleness that the skin may never become excoriated or ulcerated by the pressure of the straps, and that

the foot may always be well applied to the solepiece. The inclination of the various parts of the apparatus should therefore be varied very gradually, almost imperceptibly, and the apparatus should be frequently removed, well padded in every part where pressure may be apprehended, and the position of the straps slightly altered if any redness appears.

Very much, however, may be done without any formal instrument to remedy the abnormal position in clubfoot, sometimes without, but more generally after, the section of the tendons. Dr. Little, in an interesting pamphlet on this subject, printed for private circulation, has shown how efficiently cases of slight severity may be dealt with by daily and intelligent manipulations, the foot being secured in the best available position on a simple splint of ductile metal in the intervals, and the position gradually approximated to the natural one. The same treatment should be assiduously carried out after tenotomy, and will often be found more efficient than that by expensive apparatus, which, after all, often fit very imperfectly.

Dr. Little gives two or three months as the average period required in the infant for the mechanical treatment of the highest grade of the deformity, in which the operation and the mechanical treatment have been divided into two or three stages. After this the child may be allowed at first to move about in the apparatus, and then a boot with side-irons should be substituted during the day, the varus-shoe being replaced at night, so long as any tendency to distortion is seen or apprehended.

Talipes valgus, in which the sole of the foot instead of being flat looks outwards, is a deformity usually noncongenital, dependent on spastic contrac-

Talipes
valgus and

equino-
valgus.

tion of the peronei tendons, or partial paralysis of the tibiales. It is frequently complicated with T. equinus from weakness of the flexors, or with T. calcaneus from loss of power of the gastrocnemius.

The grade of the deformity will indicate the treatment required. It is unadvisable to divide tendons unless absolutely necessary; but occasionally the peronei tendons, or perhaps only the peroneus brevis, must be divided before the apparatus can be applied to rectify the position of the sole; and when the tendo Achillis is contracted it is very frequently necessary to divide it.

Talipes
calcaneus.

Pure T. calcaneus is still more rare, and it is still more rarely necessary to divide the flexor tendons.

Flatfoot.

The variety of valgus which is most commonly met with is the ordinary flatfoot, or spurious valgus. This deformity depends, in most cases, on a yielding of the calcaneo-scapoid ligament which supports the head of the astragalus and of the tendon of the tibialis posticus muscle which assists that ligament and forms so powerful a bond of union between all the bones of the tarsus.¹ The long plantar ligament is also relaxed, as are, doubtless, all the ligamentous structures of the tarsus. The consequence is that in extreme cases the arch of the foot is obliterated, the astragalus descending till it touches the ground. In the worst cases the anterior part of the foot is even drawn upwards by the tibialis anticus and the extensors of the toes till the soles become convex antero-posteriorly instead of concave. The peronei, being no longer balanced by their chief antagonist muscle, draw the sole outwards. In extreme cases there is considerable pain in motion, which seems to depend on a stretched condition of the plantar nerves. This extreme grade is rarely met with, but a slighter degree of flatfoot is a very ordinary deformity in children, especially if they have previously been weakly, who are obliged to keep standing for too long a time (as in factory labour)² or to carry heavy weights. In other cases it seems that the yielding of the arch of the foot depends on rachitic softening of the bones.

The cure of this affection in its early stage is easy, whilst in aggravated cases only imperfect relief can be afforded. In the first place, the young person should be relieved from the labour, or the protracted standing, which has caused the deformity; the arch of the foot should be supported and pressed upwards by a spring or a pad fixed on the inner side of the sole of the boot or shoe; any tendency to eversion of the foot should be opposed by side-supports;³ the weakened muscles should be galvanised; the patient



FIG. 251. Talipes calcaneo-
valgus congenitus. From
a model in the Museum
of St. George's Hospital.
In this case the foot
had six toes.—Holmes's
'Surg. Treat. of Chil-
dren's Diseases.'

¹ The reader is referred to an interesting lecture by Professor Humphry, in which he gives a clear and lucid description of the mechanism of flatfoot. He says: 'It consists in a persistent, over-extended, and incurved condition of the middle and chief joint of the tarsus, and it is due to a wearying of the muscles, more particularly the tibialis posticus, and a stretching of the ligaments, more particularly of the inner part of the calcaneo-scapoid, with the confluent fore-part of the deltoid and the calcaneo-cuboid.'—'Lancet,' vol. i. 1886, p. 531.

² See a paper by Mr. C. Roberts, in 'St. George's Hospital Reports,' vol. vii.

³ Mr. Walsham describes a new boot for flatfoot. In place of the T strap of the ordinary boot, he substitutes a broad band of solid rubber, so that continuous elastic tension is exercised on the sunken arch. This band is fastened to the boot on the outer side, passes under the sole, and is brought up on the inner side of the foot and leg and fastened to the calf-piece. A soft valgus pad is slid over the rubber strap and adjusted so as to correspond to the yielding arch. 'Lancet,' Jan. 26, 1884, p. 155.

should be allowed long periods of rest in the recumbent position, but the structures should at the same time be strengthened by such an amount of brisk exercise as can be taken without fatigue, and the general health should be carefully attended to.

Mr. Ellis of Gloucester has lately published an interesting pamphlet 'On the Arch of the Foot,' in which he shows how much the natural shape of the foot depends on muscular action and muscular tone—chiefly on the integrity and power of the *tibialis posticus*, but also in a great measure, as Mr. Ellis thinks, on the *flexor longus pollicis*. Hence Mr. Ellis insists, and, as it appears to me, with incontestable accuracy, on the necessity for active exercise of the muscles in the treatment of flatfoot. Persevering use of the *tibialis* and of the *flexor* muscles (the 'bowstrings,' as Mr. Ellis calls them, of the plantar arch) by standing and walking on tiptoe, hopping, and other similar exercises and games, alternated with proper periods of complete rest, will do more than



FIG. 252. A. Drawing, from a model in the Museum of St. George's Hospital, of ordinary flatfoot, or non-congenital talipes valgus.—Holmes's 'Surg. Treat. of Children's Diseases.' B. The same model drawn from behind.

any apparatus to counteract the tendency to flatfoot, and to restore the arch as far as is possible when it has been flattened out.¹

It is said that in severe cases section of the peronei tendons is justifiable; but I have never met with such a case. Dr. Ogston² described at a meeting of the Medical Society an operation for flatfoot, which consists in obtaining access to the astragalo-scapoid joint by a longitudinal incision on the inner side of the foot, chiselling off the cartilaginous surfaces of the two bones and restoring them to position, so as to reproduce the arch of the foot, and then pegging the bones together with two ivory pegs. Mr. Bryant stated in the discussion on Dr. Ogston's paper that a similar operation, but without pegging the bones, had been practised at Guy's Hospital by Mr. Golding Bird.

A rare form of talipes is described under the name of *T. cavus*, in which, without any contraction of the long tendons, the plantar fascia and short

Talipes
cavus.

¹ On the subject of the pathology and treatment of flatfoot I would refer the reader to an excellent article by Mr. Marsh in 'St. Bartholomew's Hospital Reports,' vol. xviii. pp. 32 et seq.

² 'Med. Soc. Proc.' vol. vii. p. 141.

muscles of the sole are contracted so as to bring the metatarsus nearer to the heel. This has already been discussed as a common accompaniment of the ordinary congenital clubfoot, and it is also a striking feature in many cases of congenital talipes calcaneus. As a substantive deformity I am not acquainted with it, and it would in any such case be a serious question whether its treatment would not involve as much loss of power as the deformity itself.

Relapsed
clubfoot.

Cases of relapsed clubfoot are often very difficult to treat; the tendons which had been divided having perhaps acquired adhesions to the neighbouring parts, or being so matted to the cellular tissue around, that it is by no means easy in the renewed operation to assure oneself as to their being satisfactorily divided. This applies especially to the *tibialis posticus*. The fact furnishes an additional motive for care in the original treatment of the case. But in many cases of relapse, provided the cure has at the time been complete, no further operation is necessary, for the foot can be brought straight again by manipulation and instrumental treatment.

Resection
of tarsal
bones in
talipes.

In cases of very obstinate clubfoot, where treatment has been unsuccessful or has been neglected, it may be justifiable to remove a portion of the tarsus. Either the cuboid bone may be excised, as has been done with success by Mr. Solly¹ and Mr. Davy, or the astragalus, as practised by Mr. Lund, or more extensive resection of the external tarsal bones may be practised, whether by sawing out a wedge-shaped piece or by dissecting the bones out of their articulations until the foot can be straightened. It must then be kept in its natural position on a splint till the wound has healed.²

Irregular
deformities.

It would hardly be possible to enumerate and describe the various irregular deformities which follow upon spastic contraction of muscles in infancy, the result of injury or disease of the nervous centres, or upon infantile paralysis. The principles of treatment are the same in these distortions as in the ordinary clubfoot, viz. to endeavour if possible to correct the position of the limb by properly-contrived apparatus; and if this is not possible, to divide any muscular, tendinous, or ligamentous structure which offers definite resistance, and then apply the apparatus, and continue the treatment till the limbs are straight and have recovered as much motion as the condition of the muscles will allow.

Clubhand.

One of the most grievous of the irregular deformities is 'clubhand,' in which the tendons of the wrist and fingers are contracted, and the hand variously distorted, generally in the sense of flexion. The treatment is not very successful; and, as Dr. Little has pointed out, tenotomy is by no means promising in such cases. As much good seems to be done by the persevering use of manipulation, friction, and galvanism, aided by mechanical supports and by active movement as far as possible, as can be expected from tenotomy. In fact, in the few cases in which I have myself seen the operation practised it has seemed useless, unless, perhaps, as an adjunct to mechanical treatment.

Contracted
palmar
fascia.

The hand is liable to a very inconvenient deformity from the contraction of the palmar fascia. It results usually from frequent pressure on the palm of the hand, as in those trades where some instrument is worked by the constant

¹ 'Med.-Chir. Trans.' vol. xl. p. 119.

² See Davies-Colley, 'Med.-Chir. Trans.' vol. lx. p. 11; Lund and West, 'Brit. Med. Journ.' Nov. 2, 1878. Davy, 'Brit. Med. Journ.' May 12, 1883. 'Med.-Chir. Trans.' vol. lxxviii. p. 135.

pressure of it in the hollow of the hand, or even by a patient leaning heavily on a stick in walking, though in some cases it is believed to be rheumatic in its origin. The fingers affected are generally the ring and little fingers, sometimes the middle finger only. The deformity may generally be remedied by a free division of the fascia subcutaneously in several places, and the application of an appropriate extending apparatus; but much patience and a prolonged use of passive motion will be required. This affection was first described by Dupuytren ('*Leçons Orales*'), and is often styled 'Dupuytren's contraction.' Dissection led him to conclude that the palmar fascia was alone affected, and this is also Mr. Adams's opinion.¹

Knock-knee is a most troublesome affection as it is usually seen in out-patient hospital practice; for the ignorant parents of such children have generally gone on the assumption, which is so easily adopted by people who are both poor and busy, that 'the child will grow out of it,' and have neglected it till it is hardly in a curable condition. No doubt children do grow out of knock-knee to a certain extent if the disease is only moderately severe, i.e. the limbs as they strengthen become straighter, and the gait so firm that the remaining obliquity is not noticed through the clothes. But some obliquity will be found on examination, and even this partial recovery is only obtained in the milder cases. When the knees have become very oblique further standing and walking tends rather to stretch the overstrained ligaments further and increase the deformity than to diminish it by strengthening the muscles.

Knock-knee.

Pure knock-knee, as it may be termed, consists in mere relaxation of the ligaments and muscles, whereby the natural pressure of the lower end of the femur inwards, acting on the weakened internal lateral ligament, stretches it.² This throws the tibia inwards and turns its external tuberosity somewhat upwards, whereby it is made to press on the external condyle of the femur. To this succeeds a relatively increased growth (or prominence downwards) of the internal condyle. Whether this relative increase is real—i.e. the internal condyle is hypertrophied—or apparent—i.e. the external is atrophied—it is not very easy to say;³ but the difference in the level of the two condyles is very easily verified in these cases of pure knock-knee. Again, there is a class of cases in which the knock-knee is combined with, and in the opinion of many surgeons of experience is caused by, flatfoot; while others reverse the connexion and believe the flatfoot to be caused by the knock-knee. Knock-knee is also frequently caused by rickets, the shaft of the femur being bent so that its internal part is made to press unnaturally on the ligaments of the joint. It is also the opinion of Messrs. Jules Guérin and Brodhurst that the deformity is often due to contraction of the biceps tendon and the ilio-tibial band of the fascia lata.

The ordinary knock-knee requires that the displaced bones should be drawn outwards by means of a strap or elastic spring, which is fixed to a rigid up-

¹ '*Brit. Med. Journ.*' June 29, 1878. A very interesting series of papers on this subject by Dr. Myrtle, Mr. Reeves, Mr. Adams, and Mr. Noble Smith will be found in the '*Brit. Med. Journ.*' Dec. 3 and 31, 1881, Jan. 21, 1882, and Feb. 7, 1885. In the same journal (March 7, 1885) Mr. Reeves recommends the entire excision of the contracted fascia.

² This is often termed 'statical' knock-knee. There is often some trace of old rickets, but not to any such degree as to occasion the deformity of the knee.

³ It has been proved in some cases, by dissection, that the difference in level of the condyles has depended on an obliquity of the whole epiphysis and not on any difference in the size of the condyles.

right on the outside of the leg, this upright being supported by a pelvic girdle and being let into the sole of a strong boot. By this apparatus the knee is kept fixed; and this is essential for a time. But when the obliquity has been corrected to some extent, a joint is introduced into the upright, and the child is permitted and encouraged to use the flexor and extensor muscles of the leg.

In most forms of knock-knee, the deformity is only perceptible in the extended position; that is to say, there is no increase in the antero-posterior diameter of the condyle, and consequently in complete flexion the inward inclination disappears.

In neglected cases, when the deformity is so considerable as to form a real impediment to walking, an operation should, no doubt, be performed. It must, however, be clearly understood that such operations ought never to be necessary. If the parents do their duty in bringing the deformity when incipient under medical care, and if proper splints are used, it will never increase to the extent of requiring surgical operation.

In the first class of cases, which I have called pure knock-knee, those in which no serious deformity is perceived in the bones, except the relative increase in the length of the internal condyle, the appropriate operation is that in which the projecting part of the condyle is severed from the shaft of the bone, either with a saw or chisel, and then is pushed upwards by bringing the tibia into a straight line with the femur. A small vertical incision is made down to the femur near the insertion of the adductor magnus. Then, if a saw is to be used (on Dr. Ogston's plan), a track having been made for it with the knife, by thrusting the blade down in front of the bone into the joint towards the inner side of the crucial ligaments, the condyle is severed by passing the saw through it, from before backwards, till the piece is movable. If a chisel is used (Mr. Reeves's plan), it is simply driven through the condyle downwards and outwards till the piece can be broken off. The latter plan has the merit that the knee-joint is less freely dealt with, and may possibly in some cases not be opened at all.

In cases of rickety curvature, division of the whole shaft of the femur somewhere near the epiphysis (Dr. Macewen's operation) is more appropriate in most instances. He passes a scalpel down to the internal surface of the femur at the point of intersection of a line drawn transversely a finger's breadth above the top of the external condyle, and a longitudinal one drawn half an inch in front of the adductor magnus tendon, and makes an incision an inch or more in length. A chisel, having been passed through this incision down to the bone, is then turned round so that its edge is perpendicular to the axis of the limb, and is made to penetrate the bone for about half or a third of its thickness. Then a finer chisel is applied, and if necessary a third, till the outer part of the bone will give way under slight force. If the tibia is also curved it may require division in a similar way. Mr. Barwell believes that this double division of bones is usually necessary. He first divides the external third of the femur above the epiphysial line, and then puts the limb partly straight by fracturing the rest of the bone. This leaves a triangular gap in the bone, and when this is believed to be filled up the tibia is divided transversely, and the fibula obliquely, about an inch below the joint.¹

¹ All these methods will be found described and discussed by their authors in an interesting series of papers in the 'Brit. Med. Journ.' Oct. 18, 1879. I would also refer to a clinical lecture by Mr. Barker in the same journal, July 5, 1879, and to a very interesting paper by Mr. Marsh in 'St. Bartholomew's Hospital Reports,' vol. xviii. p. 27. The chief objection to Ogston's operation, and probably also in many cases to Reeves's, is that

Finally, there are surgeons (Mr. Brodhurst, Mons. J. Guérin) who believe that by section of the tendon of the biceps, the ilio-tibial band of fascia, and the external lateral ligament, the most inveterate cases of knock-knee may be cured. I cannot accept this doctrine, though I believe that in some complicated cases these structures may require division as well as the bones.

All these operations must be performed with the minutest precautions against unhealthy suppuration which the surgeon's experience can suggest. When so performed they do not seem to involve any excessive danger, and are undoubtedly justifiable in neglected cases of genu valgum. All surgeons of experience would agree with Dr. Macewen¹ that no operation for genu valgum should be performed while the bones are still soft, for then they may no doubt be straightened either gradually or abruptly without any cutting operation. The limit may be taken as about eight years of age.

Dr. Macewen's operations have been very numerous and very successful. 'Up to April 6, 1881, there were 767 limbs osteotomised, and in these 1,149 osteotomies were performed. Out of these there were three deaths from causes independent of the operation. Of the 767 limbs operated on, 521 were for genu valgum'; and he regards the operation as not more dangerous than a simple tenotomy. At the same time it is not to be denied that troublesome suppuration, ankylosis of the joint, and even pyæmia and death, have followed on Ogston's and Reeves's operations, even in the hands of surgeons who attend minutely to antiseptic precautions; and we cannot admit that such extensive violence can be wholly free from danger, however carefully and skilfully the operation may be performed. I would repeat that proper care in the initial stages of the deformity ought to banish such operations from practice.

The same principle which underlies Dr. Macewen's operation for knock-knee has been also extensively applied by himself and other surgeons to rickety curves. There are two different ways of performing this operation. Some surgeons, as Adams, endeavour to make the section of the bone as nearly as possible subcutaneous; others, following the teaching of Mr. Lister, believe that this is not a matter of much importance, provided that the precautions are observed which, according to him, will infallibly keep the wound 'aseptic.' There are few surgeons, however, who would not think the operation safer with a small wound than a large one; and this is, I think, about the whole difference between the subcutaneous and the open method. As small a wound as possible should be made in the most advantageous position, and the bone chiselled until it will break, and then the limb is to be put up in the straight position. Very considerable deformity might require the removal of a wedge of bone, and then the operation differs in no respect from any other excision. The same observations apply to these as to operations for

Rickety deformities.

the knee-joint is opened and there is danger of inflammation and stiffness of the joint, and possibly of suppuration. MacEwen's method is almost universally adopted in preference to all others in every case, whether 'pure knock-knee' or arising from rickets.

¹ Trans. of International Med. Congress, 'Diseases of Children,' p. 190. I would refer the reader to this interesting debate for details which my space forbids me to notice. A description of the dissection of a knee-joint twenty months after Ogston's operation will be found in Langenbeck's 'Archiv,' vol. xxviii. p. 926. There was very little trace of the section on the articular cartilage, which was itself quite smooth and free from any trace of inflammation. At the upper edge of the section there was a slight projection, where the severed condyle had been pushed up; but the rest of the track of the saw was marked merely by a slight cicatrix, only visible when the bone had been sawn in half. The line of the epiphysial cartilage was broken in consequence of the displacement of the condyle about 1½ cm. upwards, but this cartilage was otherwise healthy.

knock-knee. They should not be performed while the bones are soft, and proper attention during the course of the disease ought to render them altogether superfluous.

Wryneck.

Wryneck is a common deformity in children from spastic contraction of the sterno-mastoid muscle, by which the head is drawn down towards that shoulder, and the chin turned to the opposite side; the contracted muscle stands out strongly under the skin, especially when its action is opposed by manipulation, and measurement from the ear to the sterno-clavicular joint on the two sides will at once show the extent of the contraction. Not uncommonly the size of the features on the affected side is strikingly less than on the opposite. Cases are found in which the contraction affects only the clavicular origin of the muscle, the sternal tendon being natural; or the reverse may be the case; but it is more common for both parts to be implicated. If the deformity be neglected the clavicle itself may yield and be curved upwards. The deformity is, no doubt, usually due to congenital causes, though it is often not noticed till some years after birth. The contraction involves other muscles of the neck also—the trapezius, scaleni, and others—but to a less extent; and the division of the sterno-mastoid enables the surgeon to rectify the position of the head. No milder measure has succeeded in any case which I have seen, but it is said that slighter cases may be cured by manipulation and by instruments.

Division of the sterno-mastoid.

The operation is perfectly free from danger, if carefully performed, since the muscle stands out well from the vessels below it, which are again separated by a strong membrane; but a careless operator might possibly hit the internal jugular vein, especially in trying to divide the whole muscle from the same puncture. It is safer, however, to make a different puncture for each portion of the sterno-mastoid. The head should be put well on the stretch, so as to cause the muscle to stand out fairly, and the knife should be entered behind the clavicular fibres, about half an inch above the clavicle, and passed beneath the muscle. Then its edge is turned towards the fibres, and they are divided completely. Then the surgeon deals similarly with the sternal tendon. This plan is far better, in my opinion, than that of dividing the muscle from above, by passing the knife between the skin and the muscle and turning its edge downwards, which is recommended by some surgeons. After the operation the head can be considerably raised at once; but it is well to leave the patient alone for a few days, and then I think it better to apply an instrument consisting of a frame adapted to the pelvis and shoulders, with an upright along the spine, terminating above in a padded plate which rests on the back of the head, and carries two arms, which are fixed on one temple and on the opposite side of the chin, so as to have a firm hold of the head. The upright is jointed opposite the root of the neck, and is provided with three screws, one of which raises the chin and turns it to, or even across, the middle line; the second extends the cervical spine, drawing the chin away from the sternum; and the third brings the head and neck, considered as a whole, into the proper position as regards the trunk.¹ Other surgeons trust to manipulation, or to an arrangement of strapping and bandages, to restore the position of the head; but I confess that I think the use of an apparatus renders success much more certain and the treatment less troublesome. Manipulation, however, should not be neglected. It may be practised twice a day, when the instru-

¹ A figure of this apparatus, which I believe is the most efficient, will be found in the second edition of my work on the 'Surgical Treatment of Children's Diseases,' p. 666.

ment is removed for the purpose of washing. The patient is seated on the floor, between the knees of the surgeon or attendant, who gently draws the head into the desired position. And when the chin has been got into a position somewhat on the other side of the middle line from that in which it had been fixed, and has been kept there for about three weeks, the apparatus may be gradually disused and manipulation continued for a few weeks longer.

The ordinary spasmodic wryneck is not to be confounded with wryneck from disease of the cervical vertebræ. In such cases the characteristic symptoms of disease of the spine will be found on careful examination, and no operation will be proposed. There are, again, cases in childhood in which wryneck appears to depend either on irritation from worms, or on some mental cause difficult to detect, but somewhat analogous to adult hysteria. In such cases the contraction is not permanent, but appears and disappears from time to time. In these cases, also, no operation should be performed. General treatment, with manipulation, or some contrivance to fix the head in a proper position, will suffice. The diagnosis may always be made by inducing anæsthesia, and then noting that there is no real permanent shortening of the muscle. Adults, again, suffer, though rarely, from a very obstinate and intractable form of spasmodic wryneck, somewhat allied to paralysis agitans, in which generally the other muscles of the neck are affected, and sometimes the trapezius as much as, or more than, the sterno-mastoid. The head is drawn down towards the shoulder. The affection is liable to remissions and exacerbations, evidently due to mental causes in part, and varying with the state of the mind. The disease may be due to irritation propagated from the medulla along the spinal accessory nerve; but the exciting cause of this irritation is unknown. In one case Mr. Campbell De Morgan obtained a cure by removing a part of the external branch of the spinal accessory nerve, and in other cases benefit has followed on the very free administration of the succus conii, as recommended by Dr. John Harley; ¹ but the disease usually defies treatment.

Wryneck is often also purely hysterical; and these cases are of all others the most difficult to treat. They are also difficult of diagnosis; but the ordinary rules which are applicable to the diagnosis of other hysterical disorders, and the results of an examination under anæsthesia, will usually settle the diagnosis. But they will often be most rebellious to treatment; and this, indeed, is true also of all other forms of emotional or hysterical contraction. Operation seems to aggravate the disease. The section of the sterno-mastoid in wryneck has been promptly followed by contraction of the opposite muscle. Similarly, in hysterical diseases of joints, forcible extension of an elbow, the seat of hysterical contraction, has been the starting-point of nervous disorders which have been held to justify amputation, leaving the patient still uncured; and other similar instances might be quoted. As in other nervous disorders, the less active the surgeon is the better. It may sometimes be advisable to put the parts in a natural position under anæsthesia and fix them so, and thus give the patient an irrefragable proof that the deformity is not incurable. But the chief reliance must be placed in medical and general treatment, with manipulation and calisthenic exercises when they are indicated.

Emotional
and hyste-
rical con-
tractions.

¹ 'Med.-Chir. Trans.' vol. lvii.

CHAPTER XXVII.

AFFECTIONS OF NERVES.

Wounds of
nerves.

WOUNDS of nerves occur, of course, from injuries of all kinds, but are peculiarly common in injuries from gunshot. They never occur uncomplicated, but in some cases the wound in the nerve is the chief feature of the injury. The symptoms of wound of a nerve vary according as the nerve is sensory, muscular, or mixed, and as the wound is partial or complete. Complete division of a large mixed nerve (of which the most familiar example is the ulnar or median, at the wrist) produces total loss of the function of the muscles supplied from below the point of division, and loss of sensation in the part corresponding to its distribution, together with a sensible loss of temperature in the limb below, and loss of nutrition, sometimes leading to low eruptions on the skin.¹ Division of a purely muscular nerve, such as the portio dura, is usually accompanied only by muscular paralysis—at least, as far as is known; for thermometric observations in such cases are difficult and uncertain. Division of sympathetic trunks is known to be accompanied by dilatation of the capillaries and increased heat of the parts, from experiments on animals; but in man such lesions could only form subordinate features in complicated injuries.² The anatomical phenomena of wounds of nerves and of their repair is thus described by Dr. Lockhart Clarke³:—‘Both portions of the divided nerve retract a little, and their extremities, especially the upper one, enlarge and become more vascular, while coagulable lymph exudes around and between them. In a short time this exudation becomes gradually firmer, and is found to contain cells and nuclei, and then fine nerve-fibres, which proceed from the extremity of the central portion of the nerve to that of the peripheral portion, which, on being separated from its nervous centre, undergoes a gradual but rapid atrophy or degeneration. These newly-formed fibres are finer and greyer than those of the central portion of the divided nerve, and it is not till after a period of some months that they become fully developed. In the meantime a regeneration of fine fibres is going on in the peripheral or atrophied portion of the nerve; but it is a long time before these fibres acquire the normal size and appearance. The same kind of reparative process takes place when a portion of a nerve has been excised; only it requires a longer period.’⁴ The remote consequences of wounds of nerves are very various. I have seen a case in which the total division of the musculo-spiral nerve—evidenced by complete loss of sensation in the parts supplied by the radial, and by loss of power in all the

¹ See a paper by Mr. Jonathan Hutchinson, ‘On Injuries of Nerve-trunks.’—‘London Hosp. Reports,’ vol. iii. p. 321.

² Dr. Chevasse of Birmingham, in the ‘Brit. Med. Journ.’ Dec. 17, 1881, relates a case of injury to the cervical portion of the sympathetic in a surgical operation.

³ On this point the reader may also usefully consult Dr. Weir Mitchell’s treatise on ‘Injuries of Nerves, and their Consequences,’ 1872, pp. 74, 81. This interesting work should be studied in connection with the whole subject of this chapter, as well as the translation of Charcot’s ‘Lectures on Diseases of the Nervous System,’ recently published by the New Sydenham Society.

⁴ ‘Syst. of Surg.’ 3rd ed. vol. ii. p. 186.

extensor muscles of the limb—was followed after the lapse of some months by gradual but ultimately complete recovery of all the functions of the nerve.¹ Mr. Syme has put on record a case in which the ulnar nerve was divided in an excision of the elbow, and in which the functions of the nerve were also regained; and here, on dissecting the parts some years afterwards, the ends of the divided nerve were found united by a kind of splint or ferule of fibrous tissue (exactly as a fracture is united by provisional callus), inside which the ends themselves seemed to be ununited though in contact. But in other cases there seems no doubt that a permanent irritation is generated in the substance of the wounded nerve which is reflected down other nerves, originating from the same part of the cerebro-spinal centre, and that thus the whole limb may ultimately become more or less paralysed.² There are numerous other reflex symptoms produced by injuries to the nerves, but they are too miscellaneous and too rare to make it worth while to summarise them here, and in most of the recorded cases the real symptoms have doubtless been mixed with many which were of an hysterical character. I would refer the reader to an interesting article by Dr. Brown-Séquard in the 3rd edition of the 'System of Surgery.' Partial division of nerves, or their permanent irritation by the lodgment of a foreign body, or a ligature, is liable to produce symptoms even more formidable than those caused by their complete division, though essentially of the same character. The abiding irritation which sometimes ensues on the implication of a divided nerve in a cicatrix is of the same nature. A common example of it is the irritation and jerking which occasionally attacks the stump of an amputation. Sometimes the nerve is compressed by the formation of callus around a fracture; and not unfrequently the nerves in the axilla are so pressed upon by the constant use of a crutch that a well-known form of palsy, 'crutch-palsy,' is produced.

The symptoms caused by injury to a nerve must be treated according to their gravity. Since there can be no doubt that many of the worst symptoms depend on some constant irritation, the result of partial division, the lodgment of a foreign substance, or the implication of one or more nerves in the cicatrix, it is right in such cases to cut down on the nerves which seem implicated, and either divide them completely or remove a portion of them. In cases depending on lesion of one of the digital nerves it may often be better to sacrifice the finger, and in painful stumps to re-amputate, taking care to cut all the large nerve-trunks so short that they cannot be implicated in the scar.

But in slighter cases the symptoms will probably subside by galvanism of the affected nerve, sedulously employed, blisters, the application of belladonna in ointment, and the hypodermic injection of morphia if there is much pain, with careful attention to the general health.

In all recent wounds, in which large nerves are divided, great care should be taken to put their extremities into accurate apposition, and to pass a silk or gut suture through the soft parts around or the sheath of the nerve, so as to keep them in accurate contact. In his address on Surgery, published in the 'Brit. Med. Journ.' Aug. 5, 1876, Mr. Favell refers to four cases of wounds of nerves in which the divided nerve was united by suture. In the first (under

Suture of
nerves.

¹ This case is mentioned in a paper by me in the 'Lancet,' June 16, 1883.

² See a case related by Mr. Callender, in 'Path. Trans.' vol. xv. p. 180, in which the ulnar nerve seems to have been divided in excision of the elbow, and where the whole limb became paralysed.

Mr. Wheelhouse's care), the great sciatic nerve had been cut entirely across, and its ends were united by carbolised catgut suture nine months after the accident. In the second, the median nerve was united by suture ten weeks after its division; but the result was unsatisfactory. In the two others, where the sutures were applied immediately (to the median and ulnar nerves), perfect recovery ensued. In Mr. Wheelhouse's case the man had been admitted into hospital only in order that his limb should be amputated, as it was totally palsied and useless. On cutting down on the divided nerve its proximal end was found swollen, and the distal atrophied. Both were removed, leaving a gap of two inches in the nerve. By bending the limb, the ends were brought near enough to admit of their being sewn together with catgut. Gradually the various functions of the nerve were regained, and the patient was able to use his leg. He regained the perfect use of it, and had been at work about a year as an agricultural labourer when last heard of—but lost two toes by gangrene in the cold weather.

Much more extensive experience has now been obtained of this operation of nerve suture, which justifies me, I think, in saying that in all cases where the function of a limb is lost from the division of a large nerve it is not only justifiable, but imperative, to cut down on the nerve, refresh its ends, and unite them. The prospect of success is, of course, less the longer after the accident the operation is performed; but cases are on record in which the operation has succeeded even some years after the injury. I think, however, it is better, if the nerve has not been united at once (primary suture), to wait until the wound has perfectly healed (secondary suture), and not to operate while the divided nerve and the parts around are in an inflamed condition. It should be added that the improvement in the symptoms is often long delayed. I have recorded cases in which no change was perceptible for several months after the operation, but where, ultimately, entire recovery ensued.¹

Besides the direct and remote consequences of wounds, there are a few other affections of nerves which are occasionally met with; though as a rule the symptoms which are caused by lesions of nerves are only somewhat subordinate features of surgical diseases and injuries.

Neuralgia.

Neuralgia, in its strict sense—i.e. pain referred to the course and distribution of some one or more of the sensory nerves—is a disease which is almost always periodic in its attacks, and bears a strong resemblance to ague in its course, causation, and cure, and falls more especially under the care of the physician. Still, surgeons are so often consulted about it, and an accurate diagnosis of many surgical affections depends so much on a knowledge of the phenomena of true neuralgia, that I must say a few words about it. The word neuralgia is used loosely to describe any painful affection for which no anatomical or organic cause is known; and there would be no objection to this use of the word if some other term were used to distinguish the cases which are of hysterical, dyspeptic, mental, or obscure origin from the truly neuralgic—intending by the latter term those in which there is distinct evidence of an affection limited to a precise nerve, and dependent, we cannot doubt, on some anatomical disturbance of its tissue, though this may be transient and imperceptible to our senses.

The phenomena of true neuralgia are best studied in the familiar affection known as tic, or brow-ague, which follows the course of the supra-orbital

¹ See a paper by myself in the 'Lancet,' June 16, 1883, and by Mr. Page, 'Brit. Med. Journ.' June 23, 1883.

branch of the fifth nerve. This commences very commonly by an increased afflux of blood, the pulsation in the little artery which accompanies the nerve becoming plainly perceptible to the sight and touch as the pain is coming on. Then the neighbourhood of the nerve becomes very tender to the touch, and this is followed by pain, often agonising, extending along the ramifications of the nerve. In other cases, all the branches of this or one of the other divisions of the fifth, or even all the branches of the trifacial nerve, are similarly affected, producing in the latter case what is called hemicrania. It would be beside my purpose to speculate on the cause of this affection, or to spend any time in discussing its treatment. I merely wish here to direct the reader's attention to it as illustrating an affection of the nerves quite unconnected with inflammation—for the symptoms, intolerably severe at one minute, may have entirely disappeared at another—and also, for the same reason, not due to any abiding irritation in the course of the nerve. I may, however, add that the cure of this disorder must be sought in the discovery and removal of its cause, in the amendment of any disorder of the general health, and, in cases where no cause can be ascertained, in the administration of antiperiodic remedies, as quinine and arsenic, with free purgation, and the local application of aconite, or the subcutaneous injection of morphia, or morphia and atropine, before the paroxysm. It is curious, and is valuable as a diagnostic sign, that though the parts near the affected nerve may be excessively tender to the touch, yet firm pressure will generally relieve the pain; and patients with brow-ague often learn to give themselves some relief by pressing the finger firmly into the supra-orbital notch.

Many, however, of the cases classed as true neuralgia are really not periodic but permanent affections, due to the implication of the nerve in inflammation of the bone in or near which it lies, or to its inflammation from some other cause, or to its being involved in cancerous or other ulceration, or compressed by a tumour. But in all these cases the symptoms are persistent and continuous, though not therefore necessarily equal in severity at all times. In other cases, from some irritation applied to the motor nerves, or to the part of the nervous centre with which they are connected, strange convulsive movements are produced. Spasmodic wryneck is the best known of these affections, and it manifests itself as an affection of the trapezius or sternomastoid and trapezius, which is often propagated to the other muscles of the neck and head, jerking the head about in various directions. From this origin the affection may be reflected to the nerves of the cervical or also of the brachial plexus, causing neuralgic pains in the course of their sensitive branches, with possibly some affection also of the motor nerves.

In all cases of obstinate neuralgia or of obstinate spasm, the question will ultimately occur whether any relief can be given by surgical operation, and, if so, whether the symptoms are severe enough to warrant the attempt. I say this question occurs ultimately; for it is not until all known medical treatment has failed that the division of the affected nerve ought ever to be tried, except in cases where the pain obviously depends on some irritation applied to a definite part of the trunk, and such irritation cannot be otherwise removed. In such a case it may fairly be expected that the division of the trunk above this part will relieve the symptoms. When the cause of neuralgia is central or is unknown the operation is far less promising, though under proper circumstances it is quite right to give it a trial. There are two methods of dividing a nerve; one—which is the less formidable as an operation—is to make a subcutaneous puncture, or a small incision down to

Neurotomy
and neurec-
tomy.

the bone in the known course of the nerve, by which the trunk is divided along with the parts in relation with it (neurotomy). But this is much less satisfactory than the other, both because the operator may after all miss the nerve, and because the latter may soon reunite and the symptoms recur. The more effectual method is to expose the nerve by a regular dissection, and remove a piece about half an inch long (neurectomy).¹ Dr. A. Brown² has recorded a case in which he destroyed a portion of the affected nerve with the actual cautery, and with a good result.

False
neuroma.

Tumours are sometimes painful from their pressure on nerves, and in some of the 'painful subcutaneous tumours,' as they are called, a definite nerve has been found implicated in the tumour. At other times, however, there has been no such explanation of the pain, which is then to be regarded as 'hysterical.' Like other forms of hysteria, this pain in simple, fibrous, or fatty tumours generally occurs in women.

But there are tumours formed in the substance of nerves, and which formerly were called on that account neuromata, of which a remarkable example is depicted here (Fig. 253). They are, nevertheless, not true neuromata (see page 366), and would be better styled 'false neuromata.' They are generally of a fibrous or fibro-cellular structure, grow slowly, and are often the seat of very acute pain. The fibres of the nerve will be found spread out over them and embedded in their substance. They are incurable except



FIG. 253. False neuroma. A large oval tumour, 6 inches long by 4 wide, implicating the sciatic nerve and its posterior tibial branch. The tumour is hollow, presenting a large central cavity with soft shreddy walls. The trunk of the nerve, *a*, is seen passing into the tumour above and emerging below at a point below the popliteal space. Various filaments are represented spread out on the walls of the tumour, *b b*, and many other nerves can be detected by examination in the central cavity. For about $1\frac{1}{4}$ inch above the tumour the nerve is much thickened and indurated. All that is known of the history is that the limb was amputated. The chief mass of the tumour was found on microscopical examination to consist of fibrous tissue, of various consistence, granular amorphous material, round and oval cells of the size of pus-globules for the most part, elongating fibre-cells, and remnants of nerve-tubes.—From a specimen, Ser. viii. No. 172, in St. George's Hospital Museum, described in vol. iv. of Beale's 'Archives.'

¹ Some interesting and typical cases of neurotomy in painful affections of the limbs will be found related by Mr. Redfern Davies, in the 'Dublin Quarterly Journal of Medical Science,' Nov. 1860. But the nerve which is most often divided or excised for neuralgia is the trigeminus. The division of the supra- or infra-orbital nerve in the face, either by direct dissection or by subcutaneous section, is easy. On this subject the reader may consult a paper by Mr. Cadge, 'Brit. Med. Journ.' July 15, 1882. Lately, in America, the bold idea of removing Meckel's ganglion along with the infra-orbital nerve has been put in practice. The easiest method seems to be to turn up a large V-shaped piece from the cheek, trace the nerve along the infra-orbital canal through the antrum, and open the speno-maxillary fossa by removing the back wall of the antrum. The reader who is curious on the subject will find the operation described in the second series of the 'Med. and Surg. Reports of the Boston (U.S.) City Hospital,' p. 262; but the results seem very uncertain, and it must remain doubtful whether a simple excision of a portion of the nerve would not have answered the same end.

² 'Brit. Med. Journ.' Nov. 6, 1880.

by removal; and when such removal would involve the destruction of the main nerve of the limb, and its consequent paralysis, amputation becomes necessary.¹

Latterly the operation of exposing and stretching the trunk or trunks of the affected nerves has been practised in many cases where symptoms due to irritation of the nerves have been present, which irritation it was hoped might subside after the disturbance and consequent change in the nutrition of the nerves which must be produced by their elongation. The original operation, which was most interesting and most successful, was performed by Nussbaum, and will be found related in the '*Deutsche Zeitschrift für Chir.*' 1872, vol. i. p. 450. The patient was a soldier, who, after a wound in the nape of the neck, followed by abscess, suffered from anæsthesia, contraction and violent cramps in the parts supplied by the brachial plexus, with almost permanent contraction of many of the large muscles, which, however, became quite flaccid during anæsthesia. The operation consisted in exposing the nerves surrounding the axillary artery and gently stretching each, and then exposing the brachial plexus in the subclavian triangle and following each nerve with the finger up to its point of exit from the spinal column, and stretching it by a considerable pull [einen mässigen Zug]. Sensation returned in the extremity immediately, all the cramps and other symptoms disappeared, and the man was discharged well. The original paper will well repay perusal. Mr. Callender was one of the first in this country who tried these operations, and his first case will be found recorded in '*Clin. Soc. Trans.*' vol. vii. p. 100,² in which the median nerve was exposed and stretched in a case of neuralgia, with good results during the time the patient was under observation. The operation has also been performed in tetanus and other painful disorders of the nervous system, and in locomotor ataxy, and seems occasionally to have succeeded; but the method of its action and the indications for its performance are hitherto so far unexplained that I cannot enter further into the subject here.³ I have assisted at a few of these operations, but have not hitherto seen much good from them. Still, in cases where the symptoms of nervous irritation are perfectly definite, where they are confined to a single set of nerves, or to nerves which have a common and accessible origin, and where they have resisted treatment for a sufficient period, the operation is justifiable. Verneuil recommends that the nerve should be squeezed, or crushed, as well as stretched.

Nerve-stretching.

I would refer the reader to Dr. Brown-Séquard's article, and to Mr. Marshall's '*Bradshaw*' Lecture, for all that is known on this subject at present. It seems to result from the researches which are there summarised, that no harm is likely to follow from the operation if even a greater force is

¹ As the subject is one which at present has little connection with practical surgery, I can hardly give it more space here. But the reader will be interested in studying the pathology and histology of those remarkable cases in which numerous tumours are developed in the course of nerves, apparently by an overgrowth of their fibrous sheath, in the excellent monograph of R. W. Smith, '*The Neuroma*,' Dublin, 1849; in a very interesting article by Dr. Prudden of New York on '*Multiple Neuroma*' in the '*Amer. Journ. Med. Sci.*' July 1880; and a paper by Mr. Chavasse in '*Med.-Chir. Trans.*' vol. lxi.

² See also '*Lancet*,' June 26, 1875.

³ I would refer to a paper by Dr. Cavafy in the '*Brit. Med. Journ.*' Dec. 10 and 17, 1881, in which the results of nineteen cases are summarised and some valuable remarks on the method of operating are added. Also to a paper by Mr. Walsham, in which he states that nerve-stretching in epileptiform neuralgia has been 'attended with the most happy results.'—'*Practitioner*,' vol. xxxiii. No. 1, p. 14.

employed than what is ordinarily judged advisable. Dr. Brown-Séquard thinks that the best method of stretching the nerve is to suspend a weight to it, and has shown that the sciatic nerve can bear a weight equal to that of the animal's body. He believes that the operation acts somewhat as a wound would do—i.e. by setting up an action in the distal part of the nerve followed by the same atrophy or degeneration which ensues on its division. He has also clearly proved that the effect of nerve-stretching is not limited to the nerve operated on, but is reflected to the nervous centre, and through this to other nerves of near origin. In cases especially of obstinate neuralgia or spasm where neurotomy is contemplated, it seems reasonable to make previous trial of stretching—and Dr. Brown-Séquard also recommends its use in *lepra anæsthetica*.

CHAPTER XXVIII.

DISEASES OF THE ARTERIES.

THE diseases of the arteries may be divided into (1) Inflammation; (2) Degeneration; (3) Embolism and Thrombosis.

Several varieties of arteritis, or inflammation of arteries, may be distinguished. Formerly elaborate descriptions were given of the appearance of arteries, which were believed to be in a state of acute general inflammation. It is now known, however, that no such affection really exists; and the descriptions of arteries acutely inflamed, with red lining membrane, &c., were, no doubt, mistakes, caused by confounding post-mortem staining with inflammatory injection. Inflammation.

Local arteritis is a very common condition, and may be either plastic or suppurative. Local plastic arteritis must be considered as a conservative process, following injury, such as wound or ligature of an artery, and is the means by which the vessel is permanently occluded. This condition has already been considered in connection with the subject of hæmorrhage, to which the student is referred (page 100). Suppurative local arteritis is a more serious condition, and may arise from the extension of acute suppurative inflammation in neighbouring tissues to the coats of the vessel, or from an infective thrombus or embolus in the artery, breaking down and suppurating, and the inflammation spreading from the plug to the walls of the vessel. The coats of the artery become infiltrated with granulation tissue and soften, and may ultimately give way, as sometimes occurs in a suppurating stump, or in suppurating glands in the groin or neck, the inflammation extending to the femoral and carotid artery respectively. In cases of local suppurative arteritis from embolism, the softened coats of the vessel may bulge from the pressure of the blood above the clot, and thus an aneurism may be formed. In fact, it would appear probable that most of the cases of aneurism occurring in young subjects are due to this cause.¹

Chronic arteritis (chronic endarteritis, arteritis deformans), or atheroma, is an affection of extremely common occurrence after a certain period of life. It was formerly described by Gulliver as a fatty degeneration of the coats of the vessel; but the inflammatory nature of the disease is maintained with great ability by Dr. Moxon, and is universally admitted by all pathologists. Atheroma.

There is ample proof that this condition is largely dependent on mechanical strain of the vessels, either of a continuous or intermittent nature. Thus the disease is much more common in males than in females, and especially occurs in those men who have been living a laborious life. When it occurs in females it is usually found in those who have habitually undergone considerable physical exertion. Again, the disease invariably commences in those vessels which are subjected to the greatest strain, as the aorta and its main branches. When it occurs in the medium-sized arteries, it is usually found in those which are subjected to strain from their anatomical disposition, as the cerebral, or where it is placed in close proximity to a bone,

¹ See papers by Mr. Parker, 'Med.-Chir. Trans.' vol. lxxvii. p. 51, and by Messrs. Langton and Bowlby, *ibid.* vol. lxx. p. 117.

as the femoral as it passes over the brim of the pelvis ; whereas in the pulmonary arteries, where there is little strain, atheroma is rare. Finally, the obstruction to the passage of the blood through the smallest arteries, in arterio-capillary fibrosis from granular disease of the kidney, increases the tension, or strain, in the larger arteries ; and therefore atheroma is frequently found in connection with Bright's disease. The disease begins in the deeper layer of the intima, which undergoes a round-celled infiltration. At this early stage, if the part be examined under the microscope, the deeper layers of the internal coat will be found to be infiltrated with small round cells, arranged parallel to the lamellæ. In addition to this the laminæ become thickened by fibrinous deposit. The round cells are probably the result of a proliferation of the ordinary connective-tissue cells of the part, a similar process taking place here as was described as occurring in cartilage—another non-vascular structure—when subjected to irritation (see page 9). From want of nutrition, the round cells soon undergo a fatty degeneration, and they become granular, and break up into molecular débris. This may undergo one of two changes : it may liquefy and form what is called an atheromatous abscess ; or it may calcify, forming a calcareous patch on the artery. When an atheromatous abscess is formed the contents of the so-called abscess is separated from the blood-stream by the superficial layers of the intima, with its endothelium ; these eventually give way and the contents of the abscess is washed away in the blood-current, leaving behind an excavation on the wall of the vessel—the original abscess cavity—which is now called an atheromatous ulcer. In the same way, the calcareous plates, when formed, are first covered by the superficial layers of the intima. This, however, is liable to give way, exposing the plate, which may become detached in part or whole, and form an embolus in some small vessel ; or it may act as a 'foreign substance' in the vessel and induce coagulation, and so thrombosis. Whilst these changes have been going on in the intima, the other coats of the vessel do not escape change. The muscle-cells of the middle coat become encroached upon and destroyed, and the vessel loses its contractility. The adventitia becomes much thickened by the formation in it of dense fibroid material.

Chronic endarteritis commences as small isolated streaks, which coalesce and form patches, slightly raised above the surface, of a semi-transparent grey appearance ; they are of a firm consistence, sometimes almost cartilaginous in hardness, and for the most part appear in the first place around the orifices of the branches arising from the artery. As soon as the degenerative stage commences in them they become opaque, yellowish, and softer, the alteration commencing in the central parts.

The result of chronic endarteritis is to destroy the elasticity of the vessel, and thus to cause it to become permanently dilated. It is therefore the most frequent cause of aneurism. In consequence of the disease in the coats of the vessel, atheromatous arteries are more liable to give way and rupture from external violence than a healthy vessel. The nutrition of parts supplied by atheromatous arteries is interfered with ; and this may be brought about in two ways : either from the loss of elasticity in the coats of the vessel itself, so that they can no longer take their share in the circulation of the blood ; or in consequence of the narrowing or occlusion of the orifices of the lateral branches of the artery by atheromatous deposit taking place around them. So that the parts supplied by these lateral branches are deprived of their proper supply of blood, and as a result there is malnutrition, and, as its attendant consequence, degeneration. Thus fatty degeneration of the heart is a

frequent result of atheroma of the aorta ; the atheromatous material blocking the orifices of the coronary arteries, and therefore leading to a deficient supply of blood to the heart.

Atheroma, when it has advanced sufficiently to produce elongation and tortuosity of the vessels, can be recognised in the superficial vessels, especially the temporal. The pulse is also less compressible than in the normal vessel.

Another form of arteritis is described as syphilitic arteritis. Formerly syphilis was credited with being one of the causes of the atheromatous condition above described. But its influence in the causation of this form of arteritis is exceedingly doubtful ; and at all events, with our present knowledge, we are not able to say how far, if at all, syphilis is accountable for the causation of atheroma. But there is a form of arteritis which especially affects the smaller arteries, and in this presents a notable difference to atheroma, which appears to be directly due to the syphilitic virus. It has principally been studied in connection with the arteries of the brain, and has been described by Barlow as especially occurring in the cerebral vessels of children suffering from congenital syphilis. The inner coat of the artery is the one principally involved ; this becomes enormously thickened and infiltrated with round cells, which multiply and enlarge so as to resemble ordinary granulation tissue. This may increase to such an extent as to almost or completely occlude the vessel. After a time the cells show some tendency to develop into fibrous tissue, much in the same way as ordinary granulation tissue does. In this way the lumen of the artery becomes permanently narrowed. This condition must not be mistaken for a rare form of disease to which the name arteritis obliterans has been given, in which the arteries become obliterated as the result of inflammatory changes, independently of syphilis or any other known cause.¹

Degeneration of the coats of an artery may be either fatty or calcareous.

Fatty degeneration, otherwise than as a result of chronic endarteritis, to which, as has already been shown, it is a constant sequel, is not an uncommon condition ; affecting, it is said, primarily the stellate cells in the subendothelial layer, especially in children. Another form of fatty degeneration occurs in paralysed or disused limbs, as a fatty change in the muscle-cells of the middle coats. Neither of these conditions is of any clinical importance.

Calcareous degeneration, on the other hand, as a primary affection is a matter of considerable clinical significance, and leads to important results. It affects the middle coat of medium-sized arteries, and is a constant disease of old age. It commences in the muscle-cells, with a deposit of lime-salts. As these cells are arranged with their long axis transversely to the vessel, it follows that the calcareous deposit in its earlier stage presents a series of transverse streaks or imperfect rings encircling the vessel. To this form of calcification the term *annular* calcification is applied. In the progress of the case these rings become fused together and the whole tube is converted into a rigid cylinder. This is termed *tubular* calcification. It will therefore be seen that there is an important difference between *primary* calcification, due to changes in the muscle-cells of the middle coat, and *secondary* calcification, as it is called, in which lime-salts are deposited in atheromatous patches, and in which the artery appears to be studded with calcified plates or laminae, and to which the term *laminar* calcification is sometimes given.

¹ See a paper by Mr. Pearce Gould ('Clin. Soc. Trans.' vol. xvii. p. 93), in which he gives a *résumé* of the literature of the subject.

A calcified artery can be at once recognised by its rigid feel under the finger. Its clinical significance consists in the fact that in consequence of the degeneration the artery loses its elasticity, and its lumen becomes narrowed from the thickening of the middle coat. As a result of this there is imperfect nutrition, and as a sequel, in many cases, senile gangrene; aided, no doubt, frequently by thrombosis occurring from detachment of the intima, in consequence of its deriving an imperfect nutritive supply from the vasa vasorum in the outer coat through the calcified middle coat of the vessel. Calcification is a frequent cause of secondary hæmorrhage after surgical operation; in fact, the arteries are sometimes found to be so brittle in amputations performed on aged people that they break off when an attempt is made to tie them. In such extreme cases of calcification the ligature must be used very gently, and only tied just tight enough to command the bleeding; or, what is, I think, safer, acupressure may be employed. In cases where an artery has been occluded in any way in a patient with calcareous vessels, gangrene is liable to occur, since the rigid and unyielding vessels in the neighbourhood impede the establishment of a collateral circulation.

The process of calcification is popularly denominated ossification of arteries; but there is no proof that true bone is really formed, except under very occasional circumstances. Mr. Howse¹ has recorded a case in which he found a plate of undoubted bone in the axillary artery of a patient in whom the vessel had been injured a month previously.

Another form of degeneration affecting the coats of arteries is lardaceous disease, occurring in those vessels which are contained in organs which have undergone a like degeneration. The walls of the vessels give the characteristic reaction with iodine, and in consequence of the change become softened and liable to give way. Hence the hæmorrhages which sometimes occur in this condition.

Embolism.

The usual cause of obliteration of an artery is embolism or thrombosis; but they may be occluded by the pressure of tumours, though the main arteries have a wonderful power of escaping and resisting pressure. Embolism, or the impaction of a clot, generally occurs at or near the bifurcation or giving off of some large branch (see Fig. 11, p. 64). The clot is generally formed on a nucleus of fibrine which is brought down to the part from a diseased endocardium, being washed off the surface of the heart or one of its valves, as was long ago pointed out by the late Dr. Kirkes;² but clots formed in aneurisms or diseased arteries, or in the case of the pulmonary artery, in veins, sometimes prove the starting-point of embolism. This plug of fibrine being detained in the artery attracts more fibrine to itself, till the whole tube of the artery is obliterated. The obliteration is sometimes accompanied by a good deal of pain. The pulse below is, of course, lost, and sometimes the limb becomes gangrenous. A similar result usually occurs in the brain, when the softening which so constantly ensues after embolism of the cerebral arteries may be looked upon as a form of gangrene.

The occurrence of embolism can often be diagnosed. In the case figured on page 64 the symptoms were unmistakable, and the seat of lodgment of the clot could be exactly defined. But as a general rule nothing can be done, since the heart disease forbids any surgical treatment; otherwise there is no more reason why a limb should not be amputated for embolism than after the ligature of an artery.

¹ 'Path. Soc. Trans.' vol. xxviii. p. 90.

² 'Med.-Chir. Trans.' vol. xxxv.

Embolie clots, when infective, may form the starting-point of aneurism, by setting up a suppurative arteritis, as I have already shown.

Throm-
bosis.

Thrombosis, or coagulation of blood in an artery so as to form complete occlusion, may be caused by many different conditions. It occurs when a ligature is applied to a vessel; when an artery is blocked by an embolus, as pointed out above, by the embolus attracting more fibrine to itself; or by anything which impairs the integrity of the vessel, such as arteritis, atheroma, calcification. It also takes place in acute fevers, where there is feebleness of the heart's action.

An arterial thrombus gives rise primarily to anæmia and interference of function, which may terminate in gangrene. In the majority of cases of senile gangrene, thrombosis is probably the final determining cause of the affection. Secondly, arterial thrombus may be followed by congestion from retardation to the venous flow due to the loss of the *vis-à-tergo*.

Aneurism.

The term aneurism means a sac containing blood and communicating with an artery. If, therefore, the word be correctly used, there must be in every aneurism an investing membrane, or sac, which communicates with the cavity of the artery, and which contains blood, either fluid or coagulated. This investing membrane may be formed either by all the coats of the vessel or by only one or two of them, or by the cellular tissue external to the artery; and the classification of the tumours is by many authors based on this circumstance. By others aneurisms are divided according to their shape and the nature of communication between the sac and the artery. Unfortunately for the intelligibility of the subject, the term aneurism is often applied to an affection in which there is no sac, and, in the proper sense of the word, no tumour—i.e. to a subcutaneous rupture of an artery, leading to the effusion of blood into the cellular tissue. This is what is often intended by a '*diffused aneurism*'—a term which in that sense should, I think, be abandoned, since both the pathology and treatment of such an affection differ entirely from those of common aneurism.¹

Cause of
aneurism.

The *causes* of aneurism are to be sought in anything which disturbs the balance of the circulation so as to cause the wall of the artery to become unfit to resist the heart's action. Thus the artery becomes degenerated by atheroma, and the atheromatous portion gives way. Sometimes all the coats give way, so that the artery bursts; more usually, the external coat remains entire and becomes expanded over the blood. Such commencing dilatations are constantly seen in atheromatous aortæ. At first the atheromatous patch shares in the expansion, and the aneurismal pouch is then formed by all three coats of the vessel (Fig. 254). Soon the two internal coats are worn away, and on dissection it will be found that they can only be followed a short distance from the mouth of the sac, which is then formed by the external coat only (Fig. 255). It appears certain, also, that chronic inflammation may so soften the structure of the middle coat of the vessel that it is incapable of resisting the usual force of the circulation.² Such chronic inflammation was formerly believed by many pathologists to be a frequent consequence of syphilis, and the prevalence of aneurism among soldiers was thus accounted for. It seems certain that the abuse of alcohol is a predisposing cause of aneurism, though

¹ If by '*diffused aneurism*' be meant an aneurism which has burst and poured out its contents into the neighbouring parts, it would surely be better to put this into common and unmistakable English by calling it a ruptured aneurism, as it is.

² See Moxon, '*Guy's Hospital Reports*,' 3rd Series, vol. xvi. p. 431.

DIAGRAMS OF VARIOUS KINDS OF ANEURISM.



FIG. 254. True aneurism ; the sac formed by all the coats.

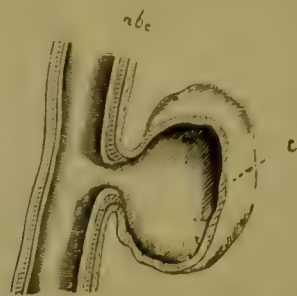


FIG. 255. 'False' aneurism : the sac formed by the outer coat only.

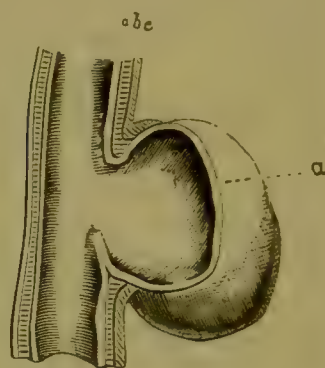


FIG. 256. 'Hernial' aneurism ; the sac formed by the inner coat only.

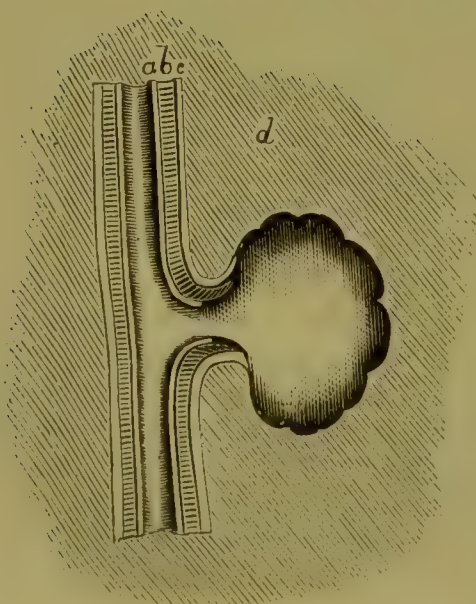


FIG. 257. Traumatic aneurism ; the sac formed by the tissues around the vessel.

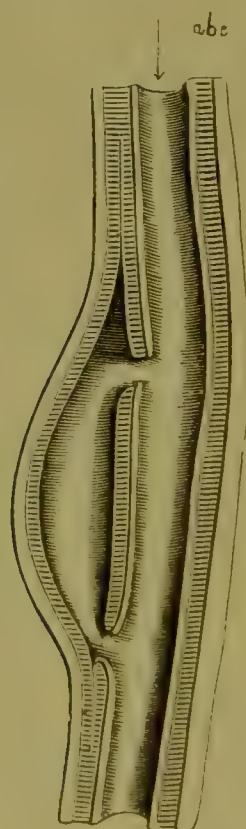


FIG. 258. Dissecting aneurism.

a, the internal coat of the artery ; *b*, the middle coat ; *c*, the external coat ; *d*, the cellular tissue, sheath, or other tissues surrounding the artery.

whether it acts by producing arterial degeneration or by irritating the heart, and exciting it to increased action, is not clear. It seems also certain that habitual strain on the heart may act in the same way; and the use of the old stock and of the knapsack in the army, inducing a strain on all the respiratory and circulating organs, is by many army surgeons considered to have been even a more potent cause of aneurism of the aorta than either syphilis or alcohol. Violence, again, leading to a partial rupture of the artery, is an undoubted cause of aneurism. This is well illustrated by an experiment of Richerand, which I have often repeated. In the dead subject, after the rigor mortis has been completely overcome by passive motion, let the knee be forcibly over-extended till the ligaments are heard to crack. The two inner coats of the popliteal artery will often be found ruptured. And there can be no doubt that something of the kind often occurs in those sprains of the knee which are so frequently assigned as the cause of popliteal aneurism. It is a known fact that sprains and blows are frequently followed by aneurism of all kinds, and it is a frequent observation that sailors are liable to axillary and subclavian aneurism, from the sprains and injuries of the upper extremity incidental to their calling, in a proportion which as much exceeds the average as does the predisposition of soldiers to aortic aneurism. Embolism has been already mentioned as an occasional cause of aneurism. Finally, the direct wound of an artery leads to aneurism (which on that account is called traumatic), by causing an extravasation of blood into the surrounding tissues, which becomes limited and encapsuled by the areolar membrane, muscles, &c., which form the sac, the coats of the artery being traceable only a very little distance into the mouth of the sac (Fig. 257). It is well to keep these facts in view in examining a case of aneurism, since the causes which act by producing general arterial degeneration offer less prospect of the success of local measures than those which are more localised; while the purely traumatic aneurism may be treated, if it seems advisable, as a wound of an artery, with the same prospect of finding the vessel healthy up to the mouth of the sac.

Aneurism is very rare in childhood, and the great majority of the recorded cases seem to have been caused either by injury or embolism. And an external or surgical aneurism is very rare in the female sex.

Influence of
age and
sex.

The old classification of aneurism was founded on the composition of the sac, an aneurism in which the sac is formed of all the three coats being termed *true* (Fig. 254); one in which the external coat only is involved, *false* (Fig. 255);¹ and one in which the sac is formed of the surrounding tissues, *diffused*,² or *consecutive* (Fig. 257).

Classifica-
tion of
aneurism.

This nomenclature is certainly neither felicitous in expression nor useful in practice. It is impossible to tell without dissection what the composition of the sac may be. The three coats of the artery can hardly ever be traced over the whole sac, except at the very commencement of the formation of

¹ A variety of 'false' aneurism has been described which is termed *hernia* (Fig. 256), in which the sac is supposed to be formed of the two internal coats, protruded or herniated through a deficiency in the external coat. The existence of this form of aneurism as a spontaneous formation seems, however, to be (to say the least) doubtful, though an undoubted instance of its occurrence has been reported in an artery whose external coat had been shaved in an amputation, without the tube of the vessel being cut into. It may also be artificially produced in animals.

² The term 'diffused false aneurism' is, however, often used, in the other sense spoken of above, to signify a ruptured artery or aneurism.

aneurism, and then almost exclusively in the case of the aorta; so that many pathologists deny the existence of 'true' aneurism; yet the use of the term 'false' seems to imply something exceptional in a condition which is really almost universal. It would be better to call all arterial aneurisms in which the sac is formed wholly or chiefly by the wall of the vessel *true*, and those in which it is formed wholly or almost wholly by the surrounding tissues *false*; and many authors use the terms in this sense.

Another classification regards the shape of the tumour. It is very common in the aorta, and not uncommon in other arteries, to find the whole tube dilated for a very considerable extent to twice or more times its natural

size (Fig. 259). This is called *aneurismal dilatation*, or *tubular* or *fusiform* aneurism, while the aneurisms which stand out from one part of the circumference of the vessel, like a bud attached to the artery by a neck, are called *sacculated*.

A still more practical distinction is, according to their apparent cause, into *spontaneous* and *traumatic*.

Dissecting
aneurism.

All this refers to the true arterial aneurism. There are other conditions which are also called aneurisms, but which have only a remote resemblance to the genuine aneurismal tumours. The internal coat of the aorta may become eroded from atheroma before any adhesion of the tunics around the patch has taken place, and then the blood may find its way between the coats of the vessel. Dr. Peacock taught that the blood always passed into the substance of the middle coat, and no doubt it is very common for it to do so; but I believe that it is sometimes extravasated between the internal and middle coats. The blood dissects off the external from the internal part of the wall of the aorta, and has been known to proceed as far downwards as the external iliac artery. Ultimately it usually bursts through the outer coat of the artery, producing fatal hæmorrhage; and this may take place in the reverse direction to that of the circulation, so that many such cases prove fatal by rupture into the pericardium. In rarer cases the blood bursts through the internal coats, and thus makes its way back into the artery again. Such cases were described in old pathological works as instances of double aorta. The name of '*dissecting aneurism*' is given to this condition (Fig. 258). In rare cases it may be diagnosed.¹ It admits of no curative treatment. As it has hitherto only been met with originating in the aorta,

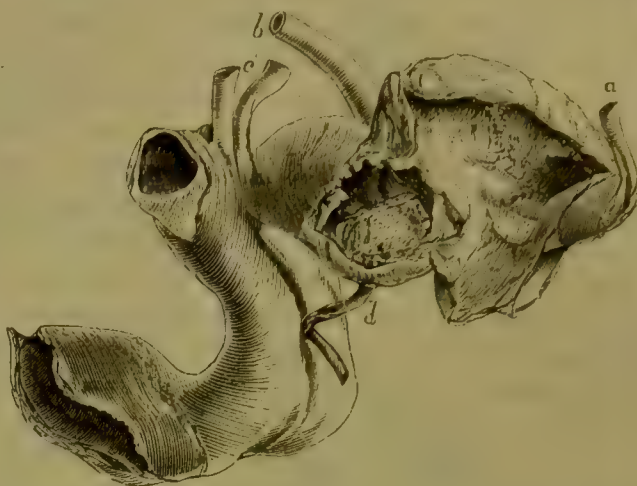


FIG. 259. Posterior view of a tubular aneurism, or aneurismal dilatation of the innominate and right subclavian artery extending from the arch of the aorta to the axillary artery. Its distal end could be felt as a round pulsating tumour in the axilla. *a* shows the axillary artery, which itself is perfectly natural; *b*, the right carotid; *c*, the left carotid and subclavian; *d*, a large branch of the right subclavian (probably the internal mammary, which is hanging down and touching the arch of the aorta). The arch itself is irregularly dilated, but the root of the innominate artery is little more than the natural size. The position of the parts has been reversed, in order to show the aneurismal cavity irregularly occupied by clot. --St. George's Hospital Museum, Ser. vi. No. 204.

¹ See a case by Dr. Swayne of York, in 'Path. Trans.' vol. vii. p. 106.

it falls rather within the province of the physician, and I shall say no more about it here.

Another condition somewhat allied to aneurism is that which is called *cirroid aneurism*, or *arterial varix*, in which a single artery becomes dilated and elongated, very much as a varicose vein does ; and closely allied to this

Cirroid
aneurism.

(often, indeed, in practice indistinguishable from it) is the condition denominated *aneurism by anastomosis*, in which there are a number of such dilated and tortuous arteries packed together. In this condition the capillaries and veins become also implicated, and many of the dilated pulsating vessels seen in such tumours, and which appear to be arteries, will be found on dissection to be really veins.

Then there are vascular tumours, or enlargements, which are formed by the communication of a diseased or injured artery with a vein—*arterio-venous aneurism*. Of these there are two kinds, sufficiently distinct from each other in well-marked examples,

Arterio-
venous
aneurism.



FIG. 260. Copy from the portrait of a patient under Sir Prescott Hewett's care with cirroid aneurism of the scalp, in the Museum of St. George's Hospital.—From the 'Syst. of Surg.' 3rd ed. vol. iii. p. 93.

though not always distinguishable when deeply seated. In the first, *varicose aneurism*, there is an aneurismal tumour lying between and communicating with the artery on one side and the vein on the other, so that the two vessels open only indirectly into each other. In the second, *aneurismal varix*, the hole in the artery opens directly into the vein, no tumour whatever being present. The veins are varicose in both. They generally pulsate to some distance in the aneurismal varix, and may do so in the varicose aneurism, if the two openings in the sac are exactly opposite to each other.

The symptoms of arterio-venous aneurism are easily distinguished from those of common aneurism. When there is a tumour (varicose aneurism) it will be found to have not only a pulsation synchronous with the arterial pulse, but also a continuous thrill due to the venous stream ; and the murmur is also composed of an intermittent blowing, arterial sound, and a constant rasping or thrilling bruit (compared to the snarling of a dog, or the harsh pronunciation of the letter R) caused by the meeting of the arterial and venous streams. In an aneurismal varix the bruit will be somewhat similar ; varying in tone, however, with the varying condition of the orifice, and the varicose veins will pulsate. There is also commonly an increase of heat in the skin, and the hair and other epidermal tissues are over-nourished.

Cirroid aneurism is rarely made the subject of any treatment. If it be necessary to undertake its cure, the ligature of the trunk-artery leading to

Treatment
of these

forms of
aneurism.

it, though an exceedingly uncertain measure, is, perhaps, the best. The dilated vessel itself is too much altered in structure to bear the ligature with safety, and coagulating injections are very dangerous. But when ligature of the main trunk is inapplicable, resort must be had either to coagulating injections or to galvano-puncture; or if the tumour is not too large it may be extirpated.¹ Reference may be made to what has been said above (p. 359) about the treatment of aneurism by anastomosis, to which these cirroid aneurisms bear a very great resemblance.

Arterio-venous aneurism is very commonly the result of a wound, and in such cases the vessels will, in all probability, be healthy if the disease is not of very long standing. But when it has existed for a long time the artery becomes so dilated and thinned above the orifice of communication that no operation on it could have any chance of success. When the disease is recent it may often be cured by pressure simultaneously exercised on the artery and on the orifice of communication. This is best done by two persons, one of whom presses lightly on the point at which the arterial stream enters the tumour, with just so much force as is necessary to suspend the cooing murmur; the other compressor holds the artery at some convenient spot above the tumour, as in ordinary aneurism. If this plan fails, it is best, in recent traumatic cases, to lay open the sac (having compressed the artery above or applied Esmarch's Bandage) and tie the artery above and below the orifice. The veins may also be tied if it seems necessary. The artery has also been tied above and below the tumour without opening the sac, and with success.² The main artery and vein have also both been tied, and a cure effected. Finally, cases have been treated successfully by coagulating injections and galvano-puncture; but these plans are less certain than surgical operation, and, I believe, more dangerous, and should only be used in exceptional instances.

When the disease does not cause much inconvenience, and is not rapidly advancing, it is questionable whether the patient ought to be advised to submit to any dangerous treatment; and this is still more the case the more nearly the disease approaches to the form of true aneurismal varix, i.e. the less proof there is of the existence of a distinct tumour between the artery and vein. In many of these cases complete relief is obtained from the uniform support of the whole extremity by an elastic stocking or armlet.³

Symptoms
of aneur-
ism.

The symptoms of arterial aneurism are as follows: There is a pulsating tumour situated in the course of the artery, and incapable of being drawn away from it; the pulsation is of a heaving character, and causes an expansion of the tumour in all directions, laterally as well as up and down. It is usually accompanied by a *bruit*—a blowing or whistling sound—synchronous with the pulse. Pressure on the artery above suspends both pulsation and bruit: and if the blood in the aneurism is entirely fluid the tumour can now be almost emptied by pressure. The tumour refills in a certain number of pulsations on the withdrawal of the pressure. In some cases pressure on the artery below will cause an increase in the size or tension of the sac. The pulse in the artery below is generally much weakened, and there are various

¹ See a paper by Mr. Edmunds ('Med.-Chir. Trans.' vol. lxviii. p. 31) 'on a case of cirroid aneurism on the dorsum of the foot, with remarks on the disease.'

² By Mr. Spence. See a lecture on Femoral Aneurism, in the 'Lancet,' Oct. 17, 1874. Since the publication of that paper Mr. Annandale has recorded two cases in which he laid open an arterio-venous aneurism in the thigh and in the leg, and tied both the vein and artery with success. No gangrene occurred.

³ See a paper by Mr. Hulke, 'Clin. Soc. Trans.' vol. viii. p. 175.

symptoms due to the pressure of the tumour on neighbouring organs, and depending, therefore, on its anatomical relations. Thus popliteal aneurism causes pain and numbness in the course of the internal popliteal nerve, and œdema of the leg from pressure on the vein; subclavian and axillary aneurism cause pain in the brachial plexus, weakness and œdema of the arm; aortic aneurism, cough, hoarseness, pain between the shoulders, and various symptoms too numerous to catalogue: in fact, each form of aneurism has its own definite symptoms, due not to its nature but to its position.

The diagnosis of surgical or external aneurism is usually, but not always, Diagnosis easy; that of thoracic aneurism often very difficult.¹ The reason is that in thoracic aneurisms there is very often no bruit, and the pulsation may be imperceptible, so that the pressure-effects furnish the only symptoms; and these can hardly be decisive of the nature, even if they can prove the existence, of a tumour. Even in external aneurism certain sources of ambiguity are found. A tumour of a solid or cystic consistence may lie so close to an artery as to derive pulsation from the vessel. A familiar instance is found in a cyst of the thyroid body which often touches the carotid or innominate artery, or a cyst or enlarged gland in the ham which may press upon and derive pulsation from the popliteal. But such tumours have never the definite whirr of the aneurismal bruit, even if some dull 'thud' is caused by the pressure they exert on the artery. It will be found that a similar sound can be produced by pressing the stethoscope on any large accessible artery. And they never have the expansive pulsation of aneurism—only the up-and-down movement communicated to them from the underlying pulsation. But the strongest sign of all is that they can usually be drawn away from the artery and then no longer pulsate. The great difficulty, however, is to distinguish between aneurism and those malignant tumours which sometimes spring from the bones, and contain large spaces which are filled with blood, and which pulsate, from the great size of the vessels opening into them. It must be admitted that in some cases the diagnosis is hardly possible, since these pulsating tumours occasionally have a bruit, lie in exactly the situation of aneurism, and their pulsation of course disappears on compression of the trunk-vessel which feeds them. In most cases of pulsatile cancer, however, there is either no bruit or one very different from that of aneurism; the bone may be felt to be expanded in the neighbourhood of the tumour; the expansion of the tumour is much less in proportion to its size than in aneurism, and if the case is watched the pulsation may sometimes be found not to be constant. It has been known to disappear for a time and return again. Sometimes also flakes of bone may be felt in the coverings of the tumour. Again, there has often been found to be a practical difficulty in distinguishing between those blood-collections which are sometimes (though, as I contend, improperly) called diffused false aneurisms, or between aneurisms which have lost their pulsation by free rupture of the sac, and abscess. The chief diagnostic signs are the absence of inflammation of the integuments, the weakness of the pulse below the rupture, possibly coldness of the parts below, and in some cases the presence of a bruit at the point of lesion of the artery. In cases of doubt exploration with a grooved needle can do no harm, and will settle the question.²

¹ This is still more the case with intracranial aneurisms; but these hardly form part of our subject.

² See a paper On the Diagnosis of Aneurism, in 'St. George's Hospital Reports,' vol. vii.

Relations
between
the sac and
artery.

The relations of the aneurismal sac to the artery are a matter of some importance. Very often a single part only of the artery has given way, although a considerable part of the vessel is, as it were, buried in the sac (Fig. 262); at other times, even in a sacculated aneurism, the whole circum-

ference of the artery has given way, and there are two openings, one of entrance and one of exit, separated by a considerable interval (Fig. 263). This is, of course, always the case in a fusiform aneurism. The walls of the artery are by no means always diseased in the neighbourhood of the mouth of the aneurism. Still, it remains true that this part of the artery is, in a spontaneous aneurism, more likely to be found diseased than any other, and that operations on that part ought therefore to be avoided if possible.

The usual progress of aneurism is to the rupture of the sac. The tumour increases gradually; it comes into contact with neighbouring structures, which it compresses and

Progress of
aneurism.

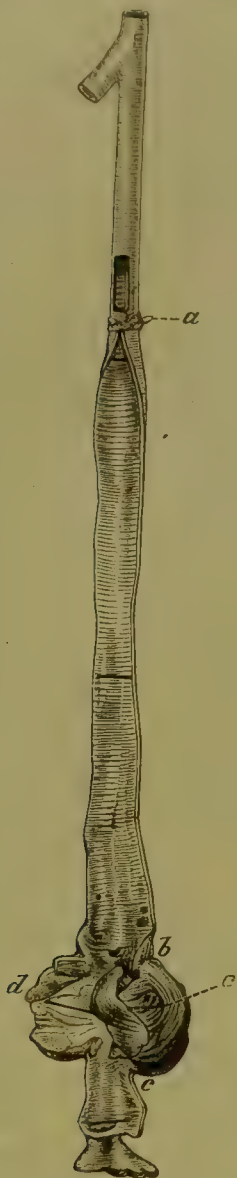


FIG. 261. A small popliteal aneurism which was in process of cure by ligation of the femoral artery seven days before death. *a* shows the point where the artery was tied. There is a groove or constriction round the vessel at this point filled up with inflammatory material, and the knot of the catgut ligature is pointed to by the letter *a*. *b* and *c* show the two mouths of the sac—the artery opening freely into and out of the aneurism. *d* points to the wall of the sac, and *e* to a bristle inserted between the layers of the clot, which was almost, but not completely, consolidated. The preparation is in the Museum of St. George's Hospital, Ser. vi. No. 127*a*. The case is fully reported in 'Clin. Trans.' vol. ix. p. 19. Death was caused by drinking an enormous quantity of raw spirit (acute alcohol-poisoning).

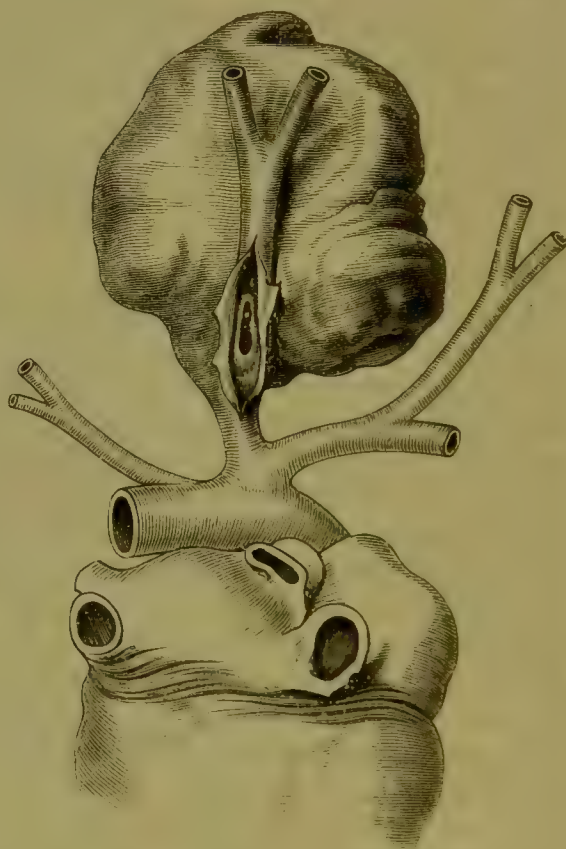


FIG. 262. Posterior view of an aneurism of the carotid artery, after Scarpa (Tav. viii. fig. 5), to show that the artery has given way at a single point, and is embedded in the sac for some distance, but is free of the aneurism above and below. This is the condition which Mr. Syme described as normal, and to which his method of operating is applicable.

absorbs, and which in their turn also compress and cause the absorption of the tissue which forms the sac. Thus, in thoracic and abdominal aneurisms, the spinal column is absorbed by pressure till the theca is often

Symptoms
and treat-
ment of
rupture of
aneurism.

exposed; in popliteal aneurism the femur and the posterior ligament of the knee-joint are worn away, &c. And as this goes on the sac softens and its tissue is replaced by the fasciæ, muscles, or bones which the sac has met with in its progress, until it gives way and the blood exudes. This sometimes occurs by a sudden rent, the symptoms of which, if it takes place into the cellular spaces of a limb or into a joint, are sufficiently well marked. The tumour suddenly loses its pulsation and its shape, becoming flattened; a sharp sensation of a crack, or of something giving way, often accompanies this; the limb becomes swollen and cold; possibly ecchymosis may be perceptible beneath the surface. If nothing is done gangrene will probably ensue. When the rupture occurs through a serous surface it is often by a sudden crack, accompanied by rapidly fatal hæmorrhage. On mucous sur-

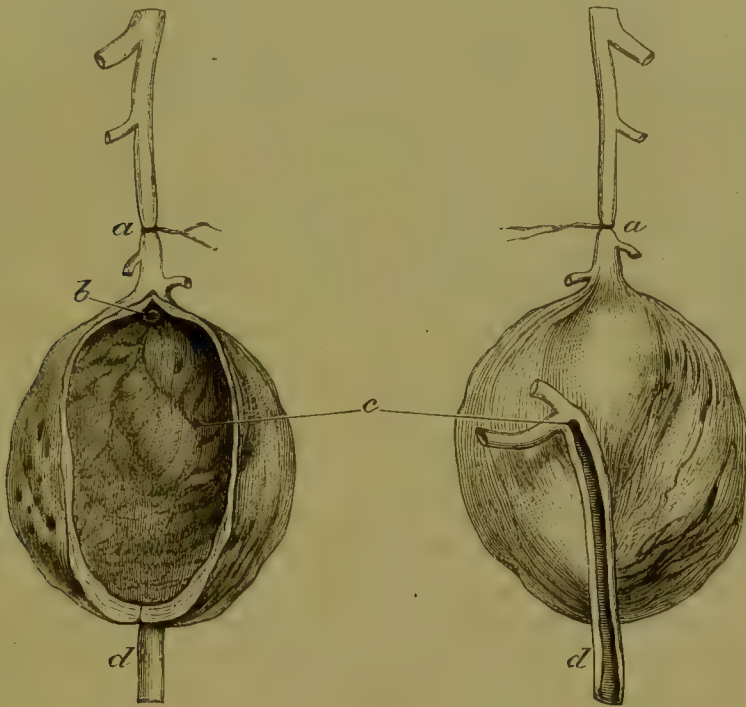


FIG. 263. Anterior and posterior view of a preparation in the Museum of St. George's Hospital (Ser. vi. No. 118), in which the external iliac artery was tied for aneurism of the common femoral. To show a very common condition intermediate between the two preceding, in which there are two openings into the aneurismal sac, though a portion of the artery is buried in the sac wall, as in the previous fig. (No. 262). *a* shows the ligature on the external iliac artery; *b*, the opening of the common femoral into the sac; *c*, the opening out of the sac; *d*, the artery as it leaves the sac. The main portion of it (superficial femoral) is seen to be embedded in the sac for a considerable distance. One of the great branches which spring from the artery as it leaves the sac is doubtless the profunda femoris.

faces the bleeding is usually gradual.¹ Aneurisms do not often burst through the skin; when they do, the bleeding is generally, but not always, fatal at once.

The treatment of cases of ruptured aneurism is not often successful. In the limbs, the first question is whether it will not be better to amputate. If gangrene seems imminent, or there are any special features of danger in the case, this may be the best course; but in uncomplicated cases the ligature has been successfully employed, and some have even been cured by pressure. In some situations the surgeon may think himself justified in laying open the sac and seeking both ends of the bleeding vessel; and life may be, for the moment at any rate, preserved by carefully plugging the sac with sponge, lint, or other substance soaked in perchloride of iron, or in carbolic acid—or, as

¹ See Gairdner, in 'Med.-Chir. Trans.' vol. xlii.

suggested by a recent American writer, by plugging the opening of the artery into the sac.¹ I am not aware, however, that the plugging of an aneurismal sac has ever done more than delay the fatal event.

Spontaneous cure of aneurism.

Spontaneous cure may take place, though it is not of common occurrence. At the same time, in most sacculated aneurisms at all events, there is a tendency to spontaneous cure, for generally there is a certain amount of clot deposited on its internal surface during life, just in the same manner as when the disease is cured by surgical operation. The manner in which this deposit is brought about is therefore of interest, as bearing upon the surgical cure of the disease. The internal surface of an aneurism is roughened, and as a rule is not covered by the endothelial lining proper to arteries; and even if this membrane is present it is considerably altered in structure, and therefore presents a surface favourable to the adhesion of the leucocytes of the blood (see page 5). The blood-current is also somewhat slowed in its passage through a sacculated aneurism, from the fact that there is only one opening into the sac, and perhaps from other causes presently to be mentioned. Under these circumstances, a condition of things exists which is especially favourable for the adhesion of leucocytes to the interior of the sac. They do adhere, and then disintegrate, and thus set free their fibrin ferment and paraglobulin, which combines with the fibrinogen of the fluid blood in the sac, and so fibrin, perhaps entangling a few coloured corpuscles in its coagulation, is formed and deposited as a layer on the interior of the sac. The process is then repeated; a fresh adhesion of leucocytes takes place, another formation of fibrin, and another layer formed internal to the first. And so the process goes on, until, if cure is to result, the sac becomes completely filled by successive layers of fibrin. This deposit is named by Broca 'active clot.' Formerly it was believed that all aneurisms must be cured by the formation of laminated fibrin—active clot. But it has been shown of late that coagulation of the blood *en masse* in an aneurism may effect a cure. When from any cause, either accidentally or as a result of treatment, arrest of the flow of blood through the aneurism takes place, the blood clots—i.e. fibrin is formed, and in its coagulation entangles the red corpuscles, exactly in the same manner as when clotting takes place in blood drawn from the body. This is named by Broca 'passive clot.' It is less stable than the active clot, and may yield if from any cause a stream of blood is again admitted to the aneurism; otherwise it may lead to as complete a cure as when the sac has become obliterated by the deposit of laminated fibrin. Between these two conditions of 'active' and 'passive' clot there are numberless gradations, the fibrin in its formation entangling a greater or smaller number of coloured corpuscles in its meshes. In the fusiform aneurism there is little tendency to the spontaneous formation of laminated fibrin, inasmuch as, though the lining of the sac of the aneurism is roughened, there is no slowing of the blood-current through it, and therefore no opportunity for the leucocytes to adhere. The causes which have been credited with retarding the blood-stream through an aneurism, and so assisting in bringing about a spontaneous cure, are (1) that the tumour, gradually enlarging, may itself compress the trunk of the artery above it and so produce a hindrance to the circulation through the sac; (2) the distal opening of the aneurism, or the distal portion of the artery, may become closed by an embolic clot and so arrest the flow of blood through the sac; and (3) in some rare cases where there are two aneurisms on the same artery,

¹ See Dr. Watson on a case of femoral aneurism treated by plugging the sac, 'Am. Journ. Med. Sc.' Oct. 1876.

a clot from the proximal aneurism may be washed into the vessel between the two and so cure the distal one.

A second way in which spontaneous cure may be brought about is by suppuration of the sac, the resulting inflammation sealing both portions of the artery; and the disease may thus be cured, a mass of blood-clot, mixed with pus, being evacuated on opening the abscess.

Finally, it may be said that some aneurisms, or perhaps aneurismal dilatations, make no progress whatever for an indefinite time. It is common to find a dilatation of the root of the right carotid artery, which seems to remain in a stationary condition for many years, without producing any appreciable inconvenience to the patient, except a loss of the power of active exertion.

The treatment of aneurism is either internal (medical) or external (surgical). The internal treatment aims at producing a cure as in the first process of spontaneous cure above described. Its main object is to reduce the circulation by rest and low diet, and to keep the heart's action at a uniform level.¹ The rest should be *perfect*, the patient being never allowed to leave his bed nor to assume the erect or even the sitting posture, and everything about the bed and chamber should be carefully arranged so as to make this as little irksome as possible. The diet should be spare in quantity but nourishing in quality (say 6 to 8 oz. of solid food, of which meat forms a good part), with as little fluid as he can be persuaded to take. A little wine is usually desirable. The object is not, as in the treatment of Valsalva by repeated bleedings, to reduce the patient's strength or exhaust his supply of blood, but to keep the heart's action perfectly equable and somewhat below the standard of health, the pulse being between 60 and 70, and never varying, as far as that is possible. The bowels must be carefully regulated if necessary by the gentlest possible laxatives, no purging or constipation being permitted, since both involve disturbance. If it be necessary chloral may be given to procure sleep, or small doses of morphia injected. Under this plan, pursued for several months, much benefit may be obtained in the majority of cases of internal aneurism, and a few complete cures may be hoped for. As to medicines, none have as yet been proved to have any effect on the disease. Much benefit has, no doubt, in many cases followed the administration of iodide of potassium, and if it does not disagree with the general health a trial may be given to it. At the same time, I have often administered it with no effect whatever, and in cases where it has done good, as perfect rest has also been employed, it is impossible to say how much of the benefit was due to this. The iodide may be given in 5-grain doses three times a day, gradually increasing; and if the heart's action is excited a small quantity (ʒv.-ʒiij.) of the tincture of digitalis or Fleming's tincture of aconite (ʒiij.-v.) may be combined with it. The acetate of lead has not seemed to me to act in any way beneficially.

Treatment,
internal or
medical.

The surgical or operative methods of treating aneurism are very various. The old operation (that of Antyllus) is an imitation of the cure by suppuration. It consists in cutting into the sac, turning out the clots, tying the artery above and below the tumour, and allowing the cavity to fill up by granulation. The operation is usually difficult, always dangerous, and sometimes impossible; but it has the merit that if successful it is certain to cure the disease, which is not the case with any of the others. Mr. Syme has done much to reintroduce this operation into practice; not in popliteal aneurism,

The old
operation.

¹ See Tufnell, 'On the Successful Treatment of Internal Aneurism,' 1864.

in which there can be no doubt that other methods are preferable, but in some of the other forms—axillary, gluteal, iliac, and carotid.¹ When it is possible, a tourniquet or Esmarch's Bandage should be applied, and then, the circulation being completely commanded, the sac may be freely split open (by a crucial incision if need be), so that its interior can be inspected throughout and the opening of the vessel clearly seen. But in some cases (as in carotid aneurism) the artery on the cardiac side of the aneurism is inaccessible. It is then necessary, in order to avoid fatal hæmorrhage, to make an opening into the tumour just large enough to admit the finger, and enlarge it, if necessary, till two fingers can be introduced, the opening being all the while plugged by the fingers. Then the surgeon feels around the interior of the sac till he gets his finger on the point from whence the blood is issuing. Keeping this steadily commanded, he next splits up the sac freely, turns out all the clots, and by the help of his assistant lays bare the artery above the opening of the aneurism and ties its cardiac part. This being done, he withdraws his finger, to make sure that the direct circulation is controlled; then dissects out the distal part of the artery and ties this also, in order to bar the reflux stream.²

The
Hunterian
operation.

The Hunterian operation for aneurism consists in tying the trunk of the artery at a variable distance above the aneurismal sac. French writers usually speak of this as the method of Anel; but the difference is, that in Anel's method the artery is tied close to the sac, no branch intervening, while in Hunter's it is tied at a distance, and often a great distance (as when the external iliac is tied for an aneurism of the superficial femoral), so that in the former no branch intervenes between the ligature and the sac, while in the latter often many considerable branches arise in the interval. Anel's method selects for ligature that part of the artery which is most likely to be diseased, and in that respect has no superiority over the old operation. In many cases it would be hardly possible to carry it out without wounding the sac. In fact, it is only a part of the old operation, and the latter is in most circumstances equally feasible, more certain to cure the disease, and therefore preferable. Hunter's method is an imitation of the first mode of natural cure. It does not (as might at first sight be thought) altogether suspend the circulation through the tumour, except for a very short time, but greatly diminishes it. The collateral circulation brings back the blood into the tumour certainly after the first few hours, at which time there is often enough movement of fluid in the sac to be perceptible to the hand, and very likely even sooner. In animals it has been proved by experiment³ that the collateral circulation is restored in a very few minutes, and the same is, most likely, the case in the human subject. But this slight stream of blood, instead of retarding coagulation in the sac, promotes it.

The stress of the circulation being removed from the aneurism by the

¹ See Syme, 'Med.-Chir. Trans.' vol. xliii. p. 137, and vol. xlv. p. 381.

² There are two descriptions, and only two, as far as I know, of the old operation for traumatic aneurism of the carotid artery; one by Mr. Syme ('Observations in Clinical Surgery,' p. 154), and the other by Dr. Frothingham ('Am. Journ. Med. Sci.' Oct. 1876). In the latter the jugular vein was also wounded and was also tied. Both patients recovered. Syme's operation was, as he says, the most arduous that he ever performed. In Dr. Frothingham's case the operation was much facilitated by division of the sternomastoid muscle—but in this case the wound in the artery appears to have been at a higher level than in Mr. Syme's case. If I understand Dr. Frothingham's description, the wound in the jugular vein which necessitated the ligature of that vessel occurred during the manipulation, and was not caused by the original injury.

³ See 'Syst. of Surg.' 3rd ed. vol. iii. p. 53.

ligature of the vessel, the sac and the parts around contract upon the blood; the latter becomes gradually more and more solid, and generally no more pulsation is perceptible in the tumour. By the time the artery is permanently closed the tumour is much reduced in size; this shrinking goes on for some time, and the tumour becomes harder as it becomes smaller, till at last only a hard kernel is left, and sometimes no preceptible enlargement remains. On dissection the sac is found filled with laminæ of fibrine much resembling the coats of an onion, entirely discoloured, if old; if tolerably recent the outer layers are perfectly buff-coloured, while the inner retain more or less of colouring-matter. The artery also is usually obstructed at this part. If no considerable branch comes off between the ligature and the sac (i.e. if the case resembles Anel's operation to this extent), the whole artery from the ligature to the tumour is obliterated,¹ and a single arch of anastomosis carries the blood into the artery below the aneurism; otherwise there are two arches of anastomosis, one to convey the blood round the portion

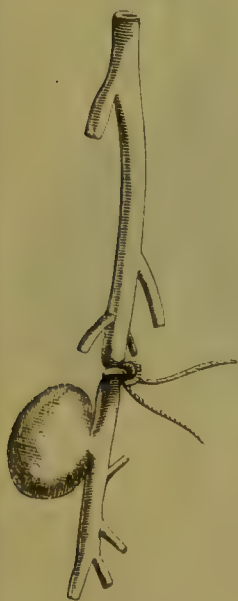


FIG. 264. Anel's operation.



FIG. 265. Hunter's operation.

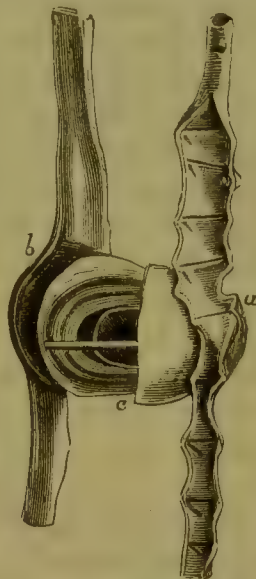


FIG. 266. A preparation showing the definitive cure of aneurism. The aneurism affected the posterior tibial artery, and the femoral had been tied some months before death. *b* shows the posterior tibial nerve spread out over the tumour, *c* a the artery, which appeared to be closed at the seat of aneurism.—St. George's Hospital Museum, Ser. vi. No. 129.

obliterated by the ligature, and the other to convey the blood round the obliterated aneurismal sac, above which there is a pervious tract of artery (Fig. 267). The arteries forming these arches of anastomosis may be exceedingly numerous.²

The main dangers which attend on this operation are those which have been spoken of as incidental to the ligature of an artery, viz. gangrene and secondary hæmorrhage (see pages 102–105); but we ought not to omit to mention that the operation may also fail in one of two ways. The more usual is the suppuration of the sac. The coagulation remains somewhat imperfect, and after a longer or shorter time—for this is very variable—the part becomes swollen, red, and painful, and an exploratory puncture will dis-

¹ On this subject see a paper by Mr. Savory ('Med.-Chir. Trans.' vol. lxx. p. 139), in which he gives a table of 26 cases of ligature of the femoral artery in Scarpa's triangle for popliteal aneurism, in none of which was the artery between the point of ligature and the aneurism rendered impervious throughout.

² See two figures (after Porta) showing the anastomotic circulation after ligature of the femoral artery ('Syst. of Surg.' 3rd ed. vol. iii. p. 52).

cover pus. It is well to wait till the matter has come near the surface, and then to open the sac pretty freely. Usually the artery will be found to be closed; and if the patient can support the suppuration the cavity will fill up, and a cure will result: but if on opening the tumour hæmorrhage ensues, or if there be bleeding afterwards, amputation is indicated.

In rarer cases the ligature does not suppress the pulsation, or after it has been temporarily suppressed it recurs. It is not very uncommon for a little pulsation to be perceptible for a short time, which ultimately disappears; but in the cases here spoken of, as a result of too free anastomosis, the tumour returns to exactly its former condition and resumes its growth. It now becomes necessary to undertake its treatment. The first indication is to employ genuflexion or pressure both directly to the tumour and to the artery above. This failing, the surgeon must choose between the ligature of the artery lower down and the old operation.¹ Both plans have been successfully adopted, and the choice would depend more on the individual features of the case than on any general principles. There might, of course, be circumstances which would render amputation more advisable.

Distal
ligature.

The distal ligature after the method of Brasdor, which consists in tying the diseased artery beyond the aneurism, or of Wardrop, in which one or more of the branches coming off beyond the aneurism are tied, is a method of treatment which is now restricted to aneurism at the root of the neck, and which will be discussed on a subsequent page in treating of that form of aneurism.

Constriction
or
temporary
ligature of
arteries.

The application of a temporary ligature, or of a constrictor, to arteries in their continuity, bears considerable resemblance to acupressure, and in fact acupressure has been used for the same purpose, but, as far

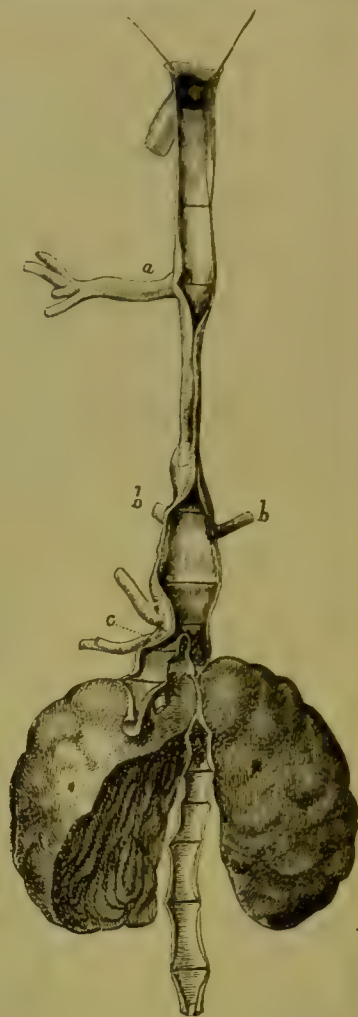


FIG. 267. A preparation showing the collateral circulation after the cure of aneurism by the ligature. The external iliac artery has been tied for the cure of aneurism of the superficial femoral. The whole length of the external iliac is obliterated, and the femoral is obliterated at the seat of aneurism. *a* points to the internal iliac, the branches from which and from the aorta have anastomosed with *b b*, the two branches of the external iliac, as well as with those of the profunda, *c*, and thus have brought the blood into the common femoral, which is enormously enlarged, so as to equal in size the common iliac artery. Again, the branches from the profunda have communicated with the superficial femoral, which is pervious from a point immediately below the aneurism.—St. George's Hospital Museum, Ser. vi. No. 120. From the 'Syst. of Surg.'

¹ An interesting case was lately published by Mr. Barker ('Brit. Med. Journ.' May 17, 1884) in which, after the ligature of the superficial femoral recurrence of the aneurism took place, a cure was effected in 6½ hours by digital compression of the common femoral. Recently, in a patient of my own, in whom I tied the femoral artery in Scarpa's triangle for popliteal aneurism, recurrence took place, and I tied the artery in Hunter's canal. The aneurism consolidated and appeared to be cured, but in the course of a few days recurrence took place, and the tumour began again to increase in size and pulsate forcibly. A most careful trial of pressure, both digital and instrumental, was now employed, but without success, and I proposed to the man to perform the old operation, but he refused further treatment, left the hospital, and was lost sight of. In this case pressure had been fairly tried before the artery was ligatured in the first instance.

as I know, unsuccessfully. Mr. Dix's wire compress, however,¹ and Dr. Fleet Spiers's artery constrictor,² are said to have been used with success. The object of this plan is to constrict the artery so forcibly for a time as to obliterate it, probably by rupturing its internal coats, whilst the external coat is left entire, so that no secondary hæmorrhage can occur. For my own part, I cannot but regard the carbolised catgut or animal ligature as a safer agent and more likely to attain the object proposed, though Dr. Fleet Spiers's invention is said to have been successfully applied to all the great arteries in the body. Mr. Bryant lately used this instrument with success in a case of popliteal aneurism. The case, as related to the British Medical Association, and the discussion on the subject, will be found in the 'Brit. Med. Journ.' Oct. 14, 1882, pp. 721 and 734.

Pressure on the artery above has now become a recognised method of treating aneurism, and on the whole has been very successful. There are many ways of doing this, amongst which, I have no hesitation in saying, compression with the finger is far the best when it can be carried out. But it must be recollected that pressure cannot be expected to succeed unless it is regular, efficient, and equable. Irregular pressure, which allows the sac to re-fill frequently, cannot but aggravate the disease by perpetual disturbances both of the sac and its contents, and causes distress and pain to the patient. Whatever form of pressure, therefore, is selected, care should be taken to ascertain by constant supervision that during the whole of its application no circulation is perceptible through the tumour.³ And it is well not to commence the treatment until, by a few days of complete rest and low diet, the circulation has been brought down to the level of health or below it, and until, as Dr. Carte suggested, a weight of about 8 lbs. laid on the artery in the groin (taking the case of popliteal aneurism) will stop the circulation in the tumour. Then, if digital pressure is to be used, a staff of assistants must be organised, who are to take charge of the artery in pairs, one holding the artery while the other keeps his hand on the tumour, to see that the pressure is effectual. Without assistance a man can hardly command the femoral artery completely for more than ten minutes, but the compressor's fingers can be much assisted by a weight or bag of shot made to fall upon the end of the finger.⁴ In this way, it is said, the same person can maintain compression for an hour. In changing the compressor care should be taken that the artery does not escape even for an instant. The process is often by no means painful, and a very rapid cure is in some instances obtained.⁵ In other cases the pressure must be intermitted, in order to give the patient

Compression treatment of aneurism.

¹ 'Med. Times and Gaz.' 1863, vol. i. p. 94.

² 'New York Arch. of Clin. Surg.' vol. i. p. 96.

³ When compression was first introduced into general use surgeons were a good deal under the influence of the theory which Broca has so strongly advocated, and only aimed at reducing, not stopping, the circulation. I believe I am correct in saying that this plan is given up even in France since the great success which has been proved to attend on digital pressure in the practice of Fanzetti and others. For digital pressure is always applied so as to stop the circulation altogether.

⁴ See Holden, in 'St. Bartholomew's Hospital Reports,' vol. viii. p. 140. A similar plan has been proposed by a French surgeon. In a case recently under my care the compressors found relief by leaning the opposite elbow on the compressing fingers.

⁵ The most rapid cures are one of femoral aneurism, under the care of Mr. Darke of Salisbury, cured in 1½ hour; one (popliteal), under Dr. Blackman, in 3 hours; and one under Vanzetti's care, in 2½ hours. 'On an average, it is said, cases of popliteal aneurism are cured by digital pressure in three days, and by instrumental in fourteen.—'Lancet,' May 8, 1875.

needful repose during the night, and resumed next morning. So long as the case goes on well—i.e. if the pulsation and size of the tumour are obviously diminishing—the treatment should be continued; but if no impression whatever is made on the disease I do not think it is wise to persevere beyond the first few days, at least in those forms of aneurism where (as in the popliteal) the operation of ligature is easy and involves comparatively little danger.

In cases where the artery lies too deep for digital compression it may be compressed manually by means of a pad mounted on a handle. A very useful instrument for this purpose was devised by the late Mr. Coles, which has been successfully employed in the compression of the carotid artery.¹ A small pad, about the size of the end of the finger, is mounted on a rod fixed in a tubular stem, with a spring so that the pad does not exercise completely dead pressure.

Instrumental compression is most easily made by means of a weight suspended from a frame, which can be improvised out of any materials that happen to be at hand, or the weight may be held by the patient or an attendant. The end of the weight ought not to be much larger than the finger, in order to avoid as far as may be the simultaneous compression of the vein or any of the neighbouring parts. But in this, as in all other forms of compression, the most careful and continuous supervision is necessary. It is obvious that any sudden movement of the patient's body may entirely displace the whole apparatus, and a few moments' negligence may undo the effect of hours of compression. Still, many cases, especially of femoral and popliteal aneurism, have been successfully treated in this way. The femoral artery in the groin is peculiarly well situated for this form of treatment.

Numerous more elaborate instruments have been devised; modifications of the Italian or horseshoe tourniquet (Signorini's), which compresses the artery by means of an arm carrying a pad, and supported on a plate moulded to the opposite side of the limb. The pad is movable, either by a joint or by a screw. The best form, I think, is Carte's Compressor, in which the arm which carries the pad is mounted on a universal joint, and is supported by stout indiarubber springs, so as to be somewhat elastic without shifting. But the great success of digital pressure has much restricted the application of these instruments, and I think it unnecessary to describe or figure their various forms. The reader will find them figured in Broca's work on Aneurism, or in the illustrated catalogues of the instrument-makers.

The advantages of the digital over the instrumental form of pressure are that it involves less risk of compressing the vein along with the artery—a drawback which is inseparable from instrumental compression; that it is less likely to ulcerate the skin; that the minimum of pressure necessary for the purpose is more easily ascertained; and that it is more easy to shift the point of its application to one at a short distance, so as to give relief to the skin at the point first compressed, yet not change to a different part of the artery.²

¹ 'Lancet,' June 14, 21, 1873.

² Mr. Walker, of Liverpool, insists, and I think with some reason, on what he calls 'the one-artery system' of pressure. That is to say, for instance, in popliteal aneurism the pressure is always to be applied either to the common or to the superficial femoral. In changing from the one to the other the system of collateral vessels is also changed, and the course of the cure interrupted. In the instrumental form of pressure it is almost always necessary to shift the pad a considerable distance; not so in the digital.—See Walker, in 'Liverpool Med. and Surg. Reports,' vol. v., and 'Lancet,' May 8, 1875, p. 639.

The advantage of instrumental over digital pressure consists in its requiring no numerous staff of trained assistants; but it does require the constant supervision of at least one well-trained and competent attendant, and is much more likely to succeed when that attendant is the surgeon himself. It very often fails from being left to students, nurses, &c., who direct the pressure wrongly or use it too severely.

The cure of aneurism by pressure is generally preceded by enlargement of the neighbouring collaterals, arteries being felt pulsating in situations where normally no artery is perceptible, and it is often accompanied by very severe pain in the part, which sometimes is so agonising that the patient declares he can bear the pain no longer, and desires that an operation may be at once performed.¹

Another method of attempting the cure of aneurism by pressure is by what is called 'rapid' pressure, i.e. the endeavour to keep the circulation entirely stopped for as long a time as may be necessary to fill the sac with clot, in the hope that definite coagulation will follow on this. Generally speaking, the proceeding is too painful to be endured without anæsthesia, and for this purpose a patient has been kept under the influence of chloroform sufficiently to bear the pressure for as many as fifty-two hours,² being permitted to recover consciousness at intervals just enough to allow him to swallow. The plan has hitherto been carried out chiefly in aneurisms of the abdomen and thigh, by compression of the aorta or one of the iliac arteries. Where the vessels are more accessible to pressure, or where their ligature does not involve very great danger, it seems very doubtful whether it is justifiable to resort to it. The pressure has in all known cases been applied by some form of tourniquet. Further particulars will be found under the head of Abdominal Aneurism.

Pressure has sometimes been made on the artery beyond the aneurism, either as an adjunct to the proximal pressure, or in situations where proximal pressure is impossible, as in aneurism of the upper part of the abdominal aorta. There seems to me to be no evidence at present of any benefit having resulted from this form of pressure; though I do not regard the attempt as unjustifiable when no better means of treatment are available. The reader may be referred to the discussion on a case reported in the sixty-eighth volume of the 'Med.-Chir. Trans.' by Mr. Lunn and Dr. Benham as one of cure of an abdominal aneurism by distal compression, for particulars of which I have not space here.

Direct compression, by means of a sponge or air-pad bandaged on to the tumour, has often succeeded in curing small aneurisms, and appears to act in much the same way as the methods of treatment to be described immediately below—genuflexion, manipulation, and Esmarch's Bandage. Like these, it is uncertain in its action, and too dangerous to be used in the more promising cases.

Flexion of the limb has often proved successful in the treatment of popliteal aneurism. It has been used also with success, I believe, in the treatment of aneurism at the bend of the elbow, and has been tried in femoral aneurism, but, as far as I can ascertain, with no definite results.³

¹ See Mr. Campbell De Morgan's case, related in the 'Syst. of Surg.' 3rd ed. vol. iii. p. 41.

² Mr. Holt's case, in 'Clin. Soc. Trans.' vol. vii. p. 56.

³ A case of Dr. Gordon Buck is always quoted in the books as a successful adaptation of flexion to femoral aneurism. A reference to the original ('Amer. Jour. Med. Sc.' 1870, p. 69) will show that the case was merely one of temporary return of pulsation after cure

Genuflexion acts by retarding the circulation much as compression of the artery does, and also, as I believe, by displacement of clot and by direct pressure on the parts, including, perhaps, the artery above the tumour, as in one mode of spontaneous cure (p. 570). It need not be enforced to an extent which is either painful to the patient or likely to injure the tumour, and if not speedily successful should not be long persisted in. The simplest cases are the best suited for it. More will be said on this subject under the head of Popliteal Aneurism.

Manipulation.

Manipulation of the tumour was introduced into practice by Sir W. Fergusson, in order to imitate another mode of spontaneous cure above described. The object of the manipulation is to press the two walls of the aneurism together, and so far to displace some of the coagula which are contained in it that they may either be carried into the distal mouth of the aneurism or at least project into the blood-stream and form a starting-point of renewed coagulation. It has been employed with success in popliteal, femoral, carotid, and subclavian aneurisms, and is an undoubtedly justifiable measure in tumours which cannot be operated on without very great danger, which are not near to bursting, and in which there is evidence of the formation of bloodclot.

Compression by Esmarch's Bandage.

Lately the use of Esmarch's Bandage has been introduced for the cure of popliteal aneurism by Staff Surgeon Reid,¹ and it has undoubtedly succeeded in some cases, including the one originally so treated—though in others it has failed, and often apparently produced harm. It is a combination of direct pressure, pressure on the artery above, and manipulation; and it is obvious that it must entail a good deal of danger, and should be used only for a limited time and only after the other and milder methods have failed. The results of this treatment, as far as they are known at present, have been collected by Mr. Gould, in the 'Transactions of the International Medical Congress,' and by Dr. Stimson, in the 'Amer. Journ. Med. Sc.' April 1881. In both lists the cures are a little above half the number of cases, and in nearly all digital or instrumental pressure has been combined with the bandage. The method usually adopted is to apply the bandage tolerably firmly on the lower part of the limb, very lightly over the aneurism, and again more firmly above, with the elastic cord. It seems hardly safe to prolong the application beyond two hours, and pressure ought always to be kept up on the artery above for a few hours after removing the bandage. The dangers are from rupture of the sac, from gangrene, and perhaps, as Mr. Gould thinks, from increase in the blood-pressure in the heart or large arteries, in consequence of the displacement of the blood from the limb. It should never, in my opinion, be used except as an adjunct to digital or instrumental pressure, and after an unsuccessful trial of these means without it. It seems to cure, partly by producing coagulation of the blood in the sac, and partly by displacement of clot, and impaction in the mouth of the aneurism,² and it should never be used when the parts around the aneurism are inflamed, or when the tumour is of large size or seems at all likely to burst. In such cases the ligature ought to be employed at once.

The injection of coagulating fluids (generally the perchloride of iron, about by compression, and that the effect of the flexion was to exercise direct pressure on the sac. It bore very little resemblance to a recent case of aneurism.

¹ 'Lancet,' 1875, vol. ii. p. 448.

² See the drawing of an aneurism cured by this method under Mr. Wagstaffe's care. 'Path. Trans.' vol. xxix.

25 per cent. of the salt) has been occasionally used with success; but it can only be rarely useful in arterial aneurism, since in order to be employed with safety it requires that the circulation should be commanded above the tumour, i.e. that the case should be amenable to ligature or pressure, which therefore is generally indicated, as the injection is neither free from danger nor by any means certain to cure the disease.

Coagulating injections.

Electricity may also be employed to coagulate the blood in the sac. A weak stream of galvanic electricity passed through the blood will be found to decompose it, hydrogen being disengaged at the negative and oxygen at the positive pole, and in this way coagulation may be commenced, which under favourable circumstances will go on until the sac is completely filled; but the method is a very uncertain one, and is liable to failure from the melting down of the soft clot which may have been formed, or it may prove fatal by setting up inflammation of the sac, or by causing sloughing around the needle-punctures, followed by hæmorrhage.

Galvano-puncture.

Finally, it has been proposed and attempted to produce coagulation in the sac by the introduction of foreign bodies into the blood which is circulating through it—much in the same way as the fibrine is whipped out of blood in a basin by a bunch of twigs. Mr. Moore¹ originated this method of treatment by introducing a large quantity of iron wire into the sac of an aortic aneurism. Considerable coagulation was produced, but the wire caused fatal inflammation of the sac-wall. Dr. Murray of Newcastle tried carbolised catgut, but without result. Recently horsehair has been used, by Dr. Levis of Pennsylvania, in a case of subclavian aneurism, and by Mr. Bryant in one of popliteal aneurism, with the effect of producing a good deal of coagulation.² Both cases, which were of a very unfavourable nature, ended fatally; but it does not appear that the foreign body caused any injury to the sac or other parts in either, and the experiment may be worth repeating in a case which is not amenable to more hopeful measures. Mr. Barwell has combined the application of the electric current with the introduction of wire. Ten yards of the finest steel wire having been passed into the sac, the positive pole was connected with the end of the wire, the negative being applied to the skin of the back. Considerable coagulation was thus produced. I have spoken above (p. 569) of plugging the sac or artery as a method which may be sometimes useful in averting death from rupture of an aneurism. But treatment which acts only on the blood in the sac holds out comparatively little hope of success. The really successful methods of treatment—rest, ligature, and pressure—are assisted in their operation by the reaction of the tissues around and of the sac itself. The weak point in the treatment by manipulation, coagulating injections, galvano-puncture and the introduction of foreign bodies, is that these methods either tend to injure or to produce inflammation of the sac-wall.

Introduction of foreign bodies.

A short exposition of the chief kinds of surgical aneurism is necessary here, to which I shall append a description of the operation of tying each artery.

Thoracic aneurism.

¹ 'Med.-Chir. Trans.' vol. xlvii. p. 129. A very remarkable case was recently published by Prof. Loreta of Bologna, and is related in the 'Brit. Med. Journ.' Ap. 11, 1885, of a large abdominal aneurism, in which Signor Loreta cut down on the tumour and filled the sac with about six feet of silvered copper wire. This was followed by consolidation of the tumour and apparent cure of the aneurism. The man, however, died soon afterwards from the bursting of the tumour.

² The preparation from Mr. Bryant's case is in the Museum of Guy's Hospital.

Aneurism
of the arch
of the aorta.

Aneurism of the arch of the aorta can only very rarely be made the subject of surgical treatment, but the surgeon should be acquainted with its main features, in order to diagnose it from other diseases, as well as to distinguish those rare cases in which operative treatment may be justifiable. Bruit is very frequently absent in thoracic aneurisms, which are often of the tubular variety, or open into the artery by a wide, unobstructed orifice.¹ The pulsation also is often imperceptible so long as the thoracic parietes remain intact, and it may be simulated by pulsation communicated by the heart to a cancerous or other tumour.² Consequently the diagnosis often rests more on the indirect than the direct symptoms. These are usually pain between the shoulders from pressure on the spine, ringing cough from pressure on the trachea, spasmodic dyspnoea, either from pressure on the recurrent nerve or on the windpipe itself, dyspnoea, hæmoptysis, and inequality of the pulse in the wrists, and sometimes also in the carotids. Very commonly one of the large branches given off by the arch is so obstructed that no pulse can be felt in its branches.

Thoracic aneurism is, as a rule, best treated by the internal or medical treatment described on p. 571. Under this plan of treatment almost every case of thoracic aneurism, and many cases of aneurism of the limbs, will rapidly improve; and in some rare cases even of aortic aneurism a complete cure may possibly be obtained. The surgical measures which are admissible in aortic aneurism are the introduction of foreign bodies, galvano-puncture or the ligature of the carotid, or of the carotid and subclavian simultaneously on Wardrop's method. The introduction of wire or horsehair into the sac of an aneurism which is rapidly growing and threatening to burst may be occasionally justifiable, and, in a case published by Dr. Cayley and Mr. Hulke, seems to have warded off death for a time.³ Galvano-puncture is, as far as our present knowledge extends, an uncertain and a dangerous measure, which, however, has yielded some good results in the skilful hands of Signor Cini-selli and others. Distal ligature seems to me to be useful or justifiable only in aneurisms believed to implicate the transverse portion of the arch and to be extending along the course of the carotid into the neck, in which case the corresponding artery (generally the left carotid) may be tied; and this has been done by Mr. C. Heath in one well-known case with very considerable benefit. The patient, an agricultural labourer, under Dr. Cockle's care, remained in good health for about four years after the operation, and earned his bread by field-work. The tumour then began to grow and proved fatal.⁴

Inno-
minate
aneurism.

Aneurism of the innominate artery is difficult to diagnose from aortic aneurism, and many cases, under the care of the best surgeons, are on record in which supposed innominate aneurisms have on dissection turned out to have been purely aortic. It forms a pulsating tumour near the right sterno-clavicular articulation, pushing the upper part of the sternum forwards, often dislocating the end of the clavicle or eroding it, and usually first presenting in the interval between the tendinous and muscular origins of the sterno-

¹ On the other hand, I have known the bruit so loud as to be heard all over the room.

² See a case reported by me in the 'Path. Trans.' vol. ix. p. 29.

³ 'Med-Chir. Trans.' vol. lxix. p. 267.

⁴ On the subject of thoracic aneurism I would refer the reader for details and discussions, for which I can find no space here, to a series of lectures published in the 'Lancet' for June and July 1872; also to Mr. Barwell's papers in the 61st and 62nd vols. of the 'Med.-Chir. Trans.' on simultaneous ligature of the carotid and subclavian artery for aortic aneurism, to his treatise on *Aneurism*, and to Dr. Wyeth's article in the 'Amer. Journ. Med. Sci.' Jan. 1881.

mastoid. More or less dyspnœa may be present from pressure on the trachea, and the pulse in the right wrist is generally much feebler than in the left. The other symptoms will vary with the size of the tumour.

In innominate, as in aortic aneurism, it is desirable to avoid surgical measures if possible, since no operation can be practised without very great danger, and the prospect of success, or even of benefit, is very slight. But if the tumour be extending in spite of the treatment by rest, and especially if it be extending along the trachea, as evidenced by its growth and by the increase of dyspnœa, it is, in my opinion, quite justifiable either to try galvano-puncture, or to tie the right carotid on Wardrop's method, or even, perhaps, to tie the subclavian artery as well.¹

The reader will find the subject of distal ligature for aneurism at the root of the neck and in the thorax fully discussed, and all the cases which I had then met with tabulated, in my article on Aneurism in the third edition of the 'System of Surgery,' vol. iii. pp. 116 to 124.

Aneurism of the carotid artery is generally situated at the bifurcation of the common carotid. It may, however, affect the common trunk lower down, or one of the secondary carotids, generally the internal. The diagnosis is usually easy, but the lower down the tumour extends the greater is the difficulty in distinguishing it from aortic aneurism;² and cases have been recorded here, and in other regions of the body, where either an abscess pressing on the artery, and receiving pulsation from it, has been mistaken for an aneurism, or, *vice versâ*, an aneurism has been mistaken for an abscess; but I do not know that the danger of mistakes is greater here than elsewhere.³

Carotid
aneurism.

An aneurism of the common carotid low down in the neck, or an aneurism of the intra-thoracic part of the left carotid (if the latter affection ever occurs, of which, as far as I know, no instance exists at present), may be treated with good prospect of success by Brasdor's operation; and it is to these aneurisms, as Hodgson and Wardrop have clearly shown, that Brasdor's operation is in strictness applicable; and a good augury of its probable success in such cases is given by the fact—which Wardrop noticed

Brasdor's
and
Wardrop's
operations.

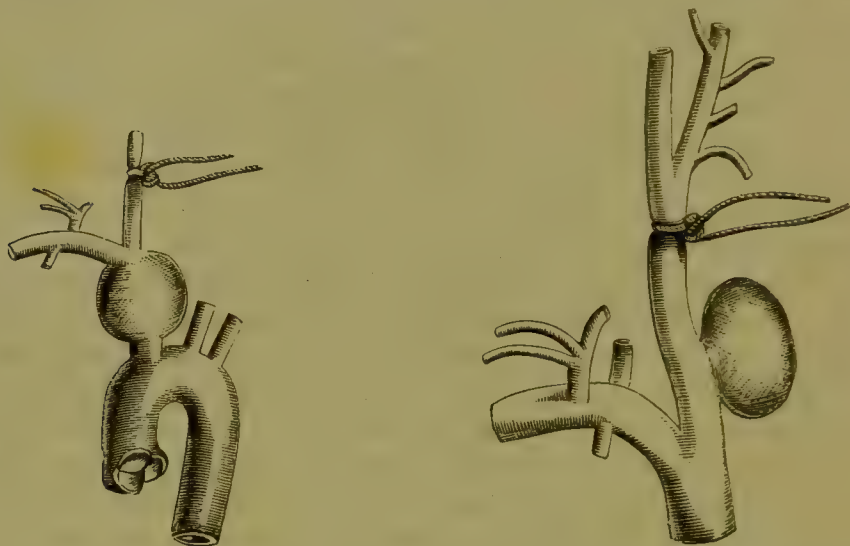
¹ As I have myself tied the subclavian (third part) and the carotid simultaneously in a case of innominate aneurism, I need hardly say that I think the distal operation justifiable in appropriate cases of this affection. But I must say that the study of my own case and of the published records of the others has led me to the decided conviction that the benefit which has been obtained in some of them has been due usually to the ligature of the carotid, by which the carotid or tracheal portion of the sac has been obliterated; and I should be disposed in any future cases to commence with the less severe measure of tying the right carotid. It must be remembered that the large branches from the first part of the subclavian must carry on the collateral circulation after the third part of that artery has been tied; and for this purpose the circulation must go on through the sac into the first part of the subclavian artery, and probably with increased force, after the operation, so that the entire obliteration of the sac by the distal ligature seems impossible unless the first part of the subclavian could be secured inside its large branches, which up to the present time has been found incompatible with the patient's recovery even without the complication of ligature of the right carotid. Still, Mr. Fearn's case, where a practical cure certainly resulted (a channel about the size of the original artery being maintained through the clot which filled the aneurism), is an encouragement for tying the two arteries either simultaneously or, perhaps better, with an interval, as in that case. Mr. Barwell is the chief authority on the subject of the double distal ligature. His last paper, giving the history of his sixth case, is to be found in 'Med.-Chir. Trans.' vol. lxviii. p. 123, and contains references to his other publications on this subject.

² See the well-known case under Sir A. Cooper's care in Allan Burns, 'On the Surgical Anatomy of the Head and Neck,' pp. 60 et sqq.

³ Traumatic aneurism of the vertebral artery has also been mistaken for carotid aneurism. On this subject see a lecture published in the 'Lancet,' July 26, 1873.

with surprise in a case in which he had tied the artery beyond the aneurism—that the tumour collapses immediately the artery is tied, instead of increasing in tension and pulsation, as it would do if the stream of blood pumped in from the heart were not diverted down the collaterals, which at once begin to enlarge. It is possible that some aneurisms seated low down on the carotid might even be cured by distal compression, but no case is at present recorded.

Aneurisms seated near the bifurcation or in one of the secondary carotids or their branches may be treated either by the old operation, by the Hunterian ligature, or by compression. The first method has been described above. Compression of the common carotid is not an easy thing either to perform or to endure; nevertheless at least five successful cases have been published.¹ It may be effected either by the finger, by an apparatus with a



FIGS. 268 and 269. The former shows Wardrop's operation, i.e. the ligature of the carotid artery for aneurism of the innominate. Wardrop's idea seems to have been that as the quantity of blood conveyed by the carotid, that by the branches of the first part of the subclavian, and that by the third part of that artery may be taken to be about equal, he could deprive the sac of one-third of its blood by tying the carotid, and of two-thirds by tying the third part of the subclavian also. He had not allowed for the increase of the collateral circulation.

FIG. 269 shows Brasdor's operation as applied to an aneurism limited to the trunk of the carotid, the only situation in which this operation can in strictness be applied.

I have shown reasons for believing that when these operations succeed they do so not so much by retarding the blood-flow through the tumour as by the extension of coagulation from the tied artery into the aneurismal sac.

movable arm carrying a small pad, or by Coles's Compressor. The point against which the carotid is most easily compressed is the anterior tubercle of the transverse process of the sixth cervical vertebra, which lies almost two inches above the clavicle, and is called sometimes 'Chassaignac's tubercle,' since that surgeon first drew attention to the comparative ease with which the artery could be compressed there.

The common carotid may be tied in any part from the root of the neck to the bifurcation, and either of the secondary carotids are accessible as high as the parotid gland. The 'lieu d'élection' for the ligature of the common trunk is at the level of the cricoid cartilage. An incision is made with its centre at this level, and in the course of the vessel (i.e. in a line from the sterno-clavicular articulation to the point midway between the angle of the

Ligature
of the
common
carotid.

¹ See 'Lancet,' June 21, 1873. See also an interesting account of a case treated at Lisbon, in which an aneurism of the external carotid was cured by intermittent digital compression of the common carotid in 40 days, comprising 283 hours of compression. 'Gaz. Med. de Paris,' Feb. 6, 1875.

jaw and mastoid process), its length being proportioned to the size of the neck. After the skin, platysma, and deep fascia have been divided the edge of the sterno-mastoid is seen, and the upper belly of the omo-hyoid may



FIG. 270. Ligature of the common carotid artery. The edge of the sterno-mastoid muscle is seen with a double blunt hook passed under it. B shows the carotid artery, with a ligature passed round it. The sheath is shown opened, and on the sheath may be seen the descendens noni nerve. Crossing the sheath is the omo-hyoid muscle, A. The opening in the sheath is represented larger than it would be made in practice, in order to show the jugular vein external to the artery and the pneumogastric nerve between the two vessels and posterior to them. In practice, however, the nerve ought never to be exposed; and the jugular vein, unless it is distended, is usually not brought into view.

be noticed passing upwards and inwards. Then the operator searches for the sheath of the vessels, lying close on the trachea, and having the descendens noni nerve generally in front of it. Having opened the sheath, the pulsation and the colour of the artery will be recognised. Then it is to be cautiously separated with the director and the point of the knife from the sheath and the vein, for a very short distance, so as to allow the needle to be got round it. Compression of the bare artery between the finger and the needle will stop the pulsation in the tumour, or, if the operation be on the distal side of the aneurism, will stop the pulse in the temporal artery; and this experiment should never be neglected, for very good surgeons have been so deceived by pulsation communicated to a piece of fascia as to tie it instead of the vessel.

The lower part of the carotid is more deeply seated, and in tying it it is better to divide the sterno-mas-

toid freely enough to expose fairly the sterno-hyoid and sterno-thyroid muscles. These muscles should then be carefully divided on a director, when the sheath will be exposed. In tying the carotid the jugular vein and pneumogastric nerve are not usually seen, but either of them may be, especially the vein, which is sometimes swollen and laps over the artery, so as to give some trouble. At the root of the neck, on the right side, the vein is separated from the artery by an interval, while on the left side it somewhat overlaps the artery. The sheath of the vessels near the root of the neck is usually covered by several veins descending from the thyroid body, which increases the difficulty of the operation. The ligature should always be passed from without inwards.

Ligature of the common carotid has hitherto proved fatal in about 40 per cent. of the cases operated on. Dr. Pilz has tabulated 600 miscellaneous cases in the 9th vol. of Langenbeck's 'Archives,' with 259 deaths. But the danger seems to depend more on the patient's general condition than on the intrinsic severity of the operation, the great mortality being in cases where the artery has been tied for hæmorrhage. In ordinary cases the death-rate is estimated at about one-third.¹

Ligature of the internal carotid is not an operation usually performed, except as a dissecting-room exercise;² but the external carotid has often

Ligature of the external carotid.

¹ 'Syst. of Surg.' 3rd ed. vol. iii. p. 130.

² In a case of distal ligature a short time ago, where the parts were much changed in

been tied,¹ in the following manner: Make an incision downwards from a little external to the angle of the jaw to near the anterior edge of the sterno-mastoid, from one-third to half an inch below the upper border of the thyroid cartilage; dissect away some cervical glands and the venous branches connected chiefly with the facial and lingual veins, which lie over the artery. The glands should not be torn away or lifted, for fear of tearing the veins, to which they adhere closely, but freely incised, and the veins tied and divided if necessary. Then look for the hypoglossal nerve, which crosses the artery obliquely, and will serve as a guide to the vessel lying immediately beneath. There is usually about half an inch of the trunk available for the purpose of placing the ligature, between the origin of the superior thyroid, which is generally close to the bifurcation, and that of the lingual, facial, and occipital above. The identity of the vessel may be known by its relation to the hypoglossal nerve, the presence of a collateral (the superior thyroid) when it happens to come into view, and the fact that pressure on the exposed vessel commands the pulse in the temporal.²

Ligature
of the
lingual
and thy-
roid
arteries.

Some of the branches of the external carotid have been tied. The lingual is the one most frequently operated upon, and mainly on account of hæmorrhage from cancer of the tongue. It has also been tied with a view of starving the growth and retarding its progress, though the success which has attended this proceeding has not been great. It is best tied by a horseshoe-shaped incision from an inch external to the symphysis of the lower jaw downwards to the greater cornu of the hyoid bone, and from thence upwards to the angle of the jaw. This incision divides the skin, superficial fascia, and platysma myoides, and exposes the deep fascia, which is to be divided on a director. The lower border of the submaxillary gland is now laid bare and is to be pulled upwards by a retractor. A small triangle, bounded by the posterior belly of the digastric above, the hypoglossal nerve below, and the posterior border of the mylo-hyoid in front, may now be seen, having for its floor the fibres of the hyo-glossus arising from the greater cornu of the hyoid bone. The fibres of this muscle are to be carefully scratched through, when the artery will be found lying on the middle constrictor of the pharynx, parallel to the upper border of the hyoid bone.

As to the other arteries in the neck I may quote the following directions:—

‘For the superior thyroid an incision is to be made, two inches long, parallel to the inner margin of the sterno-mastoid, its centre corresponding to the great cornu of the thyroid cartilage. This brings into view the omo-hyoid muscle and the sheath enclosing the jugular vein and common carotid; the fibrous lamellæ which cover the artery having been torn away with a director, the superior thyroid may be found running downwards between the main vessels and the thyroid gland; or, if the facial is the artery sought for, it can be found by the same incision, the search being conducted upwards towards the jaw, where the artery is found between the great vessels and the submaxillary gland.

‘The inferior thyroid is to be sought by an incision similar to that for the carotid in the lower part of the neck. It is usually concealed by the upper

position by the growth of the aneurism up the neck, I tied the internal carotid artery by mistake.

¹ M. Guyon quotes twenty-four cases in the 6th vol. of the ‘Mém. de la Soc. de Chir. de Paris.’ See also Cripps in ‘Med.-Chir. Trans.’ vol. lxi.

² ‘Syst. of Surg.’ vol. iii. p. 131, 3rd. ed.

part of the omo-hyoid muscle. This muscle must therefore be depressed or divided, and the artery sought for between the trachea or œsophagus and the trunk of the carotid. The recurrent nerve and the descendens noni will be endangered in this operation.’¹

Orbital aneurism is a rare disease; i.e. pulsating tumour in the orbit is rare, and true aneurism is still rarer. The case which first attracted the notice of the profession was published by Mr. Travers² as one of aneurism by anastomosis, but it is now conceded on all hands that most of the cases of pulsating tumour in the orbit are certainly not of this nature, although we may still admit the occasional occurrence of aneurism by anastomosis here, distinguished by its appropriate symptoms.³ But the objections to regarding the ordinary cases of pulsating tumour in the orbit as aneurisms by anastomosis are irresistible. Mr. Nunneley, in two most interesting papers on pulsating tumours in the orbit,⁴ succeeds, I think, in proving this point, since ‘aneurism by anastomosis involves all the neighbouring vessels, arteries, and veins in active disease; aneurism of the orbit is generally limited to a single part, or if the neighbouring vessels are dilated they seem only enlarged from obstruction—ligature of the trunk of a vessel leading to an undoubted aneurism by anastomosis is an extremely unsuccessful operation; in aneurism of the orbit, a very successful one—finally, the cases dissected have turned out to be common aneurism.’

Orbital
aneurism.

But that some of these tumours are not arterial aneurisms seems clear enough, from a tract published by M. Delens⁵ recounting two cases under the care of Nélaton, in both of which the disease was found to consist in a communication between the internal carotid artery and the venous channel in the cavernous sinus; and again, Mr. Bowman’s case (published in Streetfield’s ‘Ophthalmic Reports,’ April 1859) shows that all the ordinary symptoms of what is called ‘orbital aneurism’ may be caused by coagulation of blood in the venous sinus pressing on the carotid artery and occasioning protrusion of the eyeball.

The symptoms of ‘orbital aneurism’ (so-called) are protrusion of the eyeball, eversion of the lids, loss of vision, and pulsation; sometimes in the form of a definite rounded tumour above the eyeball, sometimes as a general pulsation, perceptible throughout the orbit.

In cases which have been followed to their conclusion uninfluenced by treatment it has been found that the tumour will sometimes subside entirely without any permanent mischief,⁶ or in some cases with loss of vision, in consequence of the long exposure of the protruded eyeball;⁷ and this is in itself a strong presumption against the presence in such instances of arterial aneurism, and a strong argument against the too early resort to any serious surgical operation.

The appearances on dissection have also been very various. In some cases, it is said, an ordinary encysted aneurism of the ophthalmic artery has

¹ ‘Syst. of Surg.’ 3rd ed. vol. iii. p. 132.

² ‘Med.-Chir. Trans.’ vol. ii. See also another case, by Mr. Dalrymple, in vol. vi.

³ See Haynes Walton, ‘Surg. Dis. of the Eye,’ 2nd ed. 1861, p. 230.

⁴ ‘Med.-Chir. Trans.’ vols. xlii. and xlviii.

⁵ ‘De la Communication de la Carotide interne et du Sinus Caverneux,’ Paris, 1870.

⁶ Erichsen, ‘Science and Art of Surgery,’ vol. ii. p. 28. Holmes, ‘Am. Journ. of Med. Sci.’ July 1864, p. 44.

⁷ France, ‘Guy’s Hosp. Reports,’ Ser. iii. vol. i. p. 58, 1855.

been found,¹ whether in the orbit or in the sella turcica.² In other cases, as in those reported by Dr. Delens from Nélaton's practice (*op. supr. cit.*) there has been a communication between the internal carotid and the venous channel of the cavernous sinus (arterio-venous aneurism), and in these the pulsating tumour over the eyeball has been proved to have been formed by a dilated and pulsating vein; in others, again, nothing beyond a collection of bloodclot (thrombosis) in the sinus pressing on the artery (as in Bowman's case).

For these reasons surgeons are now less quick than they used to be to resort to the ligature of the carotid artery in such cases. It is better at first to watch the case; and if no great inconvenience is caused by the disease it is very doubtful whether any treatment is necessary; otherwise digital pressure on the carotid artery as long and as frequently as the patient can tolerate it, is advisable. If, in spite of this, the symptoms are advancing, the choice lies between injection of perchloride of iron and ligature of the carotid.³

Subclavian aneurism.

Subclavian aneurism is a very formidable and fatal disease; like all other aneurisms near the heart, it is usually fatal if left to itself, while surgical treatment generally only hastens death. The only really successful methods of treatment in aneurism are those in which the surgeon deals, not with the blood or the contents of the sac only, but also with the sac itself and the tissues which surround it: by taking away the eccentric pressure of the blood on the walls of the sac the latter are allowed to react on the contained blood, and this is a powerful aid in the cure of the disease. On the other hand, a softened, inflamed, or ruptured sac is usually the precursor of death when the tumour is near the heart. Now, in aneurism of the first or second part of the subclavian artery, the ligature can only be applied to the innominate artery, and in aneurism of the third part of the right subclavian, to the first part of the same vessel; and both operations have proved uniformly fatal, except in one case, in which the innominate and subsequently the vertebral artery were tied by Dr. Smyth of New Orleans, and the patient survived after several severe attacks of secondary hæmorrhage. Galvano-puncture may be tried, but its effect is so commonly to set up inflammation of the sac that it must always be doubtful whether it is not more dangerous than abandoning the case to nature. The 'manipulation' of the tumour remains as the only active surgical measure; and this, though perfectly justifiable, and indeed indicated, when the sac contains a good deal of clot in one part but is growing in another, must be allowed to be a desperate measure. In cases which are not growing, perhaps gentle direct pressure may gradually effect a cure.⁴ In some cases, where aneurism affects the end of the subclavian, and the artery rises high in the neck, it may be possible to make compression, either digital or instrumental, on the artery above, as in Mr. Poland's case.⁵ If there is gangrene, or a threatening of gangrene,

¹ Guthrie's case, quoted by Nunneley.

² Nunneley, 'Med.-Chir. Trans.' vol. xlviii. p. 29.

³ The whole question of the pathology and treatment of pulsating tumours in the orbit has been elaborately discussed by Mr. Rivington in a paper which will be found in 'Med.-Chir. Trans.' vol. lviii.

⁴ A case under Mr. Corner's care is related by Mr. Poland (*op. infr. cit.*) as one of cure by direct pressure; where, however, it seems to me that the recovery was spontaneous. In a case under my own care the patient recovered under direct pressure.

⁵ 'Med.-Chir. Trans.' vol. lii. p. 277. Prof. Annandale has suggested in these cases

amputation at the shoulder-joint is indicated. The great branches of the subclavian having been removed, the aneurism may cease to grow. 'This operation has been performed four times—by Mr. Spence, Mr. Holden, Mr. H. Smith, and Mr. Heath.¹ All that can be said about it is that in Mr. Spence's case the patient was thought to have been benefited by the operation, but that in none of the others did it do any good. In Mr. Spence's case, however, the limb was threatened with gangrene, and there the operation is no doubt justifiable. In any other circumstances, it seems (to say the best of it) highly dubious' ('Syst. of Surg.').

When the surgeon has made up his mind to risk the ligature of the innominate artery, or of the first part of the right subclavian,² his best plan is to obtain free space externally by a V-shaped incision made along the inner margin of the sterno-mastoid and the upper border of the clavicle. The sterno-mastoid, having been cut away freely from the clavicle, is turned aside, and the sterno-hyoid and sterno-thyroid divided. Now the carotid sheath is fairly exposed. If the innominate is to be secured the surgeon follows the carotid down to its bifurcation and passes his finger into the thorax along the artery, which is now the innominate. This manœuvre may be somewhat facilitated by drawing the head strongly backwards. The needle must then be passed around the vessel from without inwards, as low down—i.e. as near the aorta—as can be reached, great care being exercised to avoid puncturing or contusing the right innominate vein. A needle with a sharper curve than ordinary may be employed, or some special contrivance provided with a catch for drawing up the ligature.³

Ligature of the innominate or first part of the right subclavian.

If the surgeon intends to tie the first part of the right subclavian, this can only be done just external to the point where the pneumogastric nerve crosses it. On the right side a triangular interspace is left between the carotid artery and the jugular vein, and here the nerve is seen crossing the artery. As the recurrent laryngeal runs inwards round the vessel, and as the phrenic nerve crosses the artery close to its termination, neither of these important nerves will probably be injured; but sympathetic filaments must almost necessarily be interfered with, while the proximity of the large branches of the artery almost necessitates secondary hæmorrhage (of which the great majority of those operated on have died); and the risk of wounding the large veins or the pleura has also to be considered. This operation has never as yet been successful.

Axillary aneurism is a more common affection than subclavian, the free movement of the joint, near which the artery passes, rendering it liable to

Axillary aneurism.

compression of the innominate artery against the posterior surface of the sternum by means of a compressor which he has especially devised for this purpose. One blade of the instrument is introduced by a median cervical incision behind the artery, the other is placed outside over the sternum and the pressure regulated by a screw. 'Lancet,' vol. i. 1886, p. 481.

¹ See a paper by Mr. Heath, 'Med.-Chir. Trans.' vol. lxiii. p. 65.

² The left subclavian has been tied in its first part behind the apex of the left lung by Dr. J. K. Rodgers of New York, but the operation is so difficult that most surgical writers have spoken of it as impracticable; and it is known that Sir A. Cooper, having attempted it, was obliged to desist, believing that he had injured the thoracic duct. It is hardly worth while to spend time in describing an operation which will probably not be repeated.

³ The last case of ligature of the innominate artery was under the care of Mr. Thomson of Dublin. It was published in the 'Brit. Med. Journ.' Oct. 14, 1882. The reader will there find a full account of the case and operation, and a summary of all the recorded cases. They are 19 in number—16 for aneurism and 3 for secondary hæmorrhage. All proved fatal except Dr. Smyth's.

slight injuries, though in a less degree than the popliteal, which is exposed to injury from a similar cause; so that these aneurisms are frequently found to follow upon sprains and contusions. Total rupture of the axillary artery has been known to be produced by the efforts to reduce a dislocation of the shoulder-joint.¹

There is usually little or no difficulty in the diagnosis, but the treatment is only too frequently unsuccessful. Three principal measures have to be considered: 1. The ligature of the subclavian artery was long the only resource in this form of aneurism, and it still remains the most easy of application; but it is doubtful whether it is the safest, since the mortality has been very great. Since, however, the introduction of better methods of wound treatment and materials for ligature, the mortality has been much reduced,² and there seems nowadays no reason for excluding cases of axillary aneurism from treatment by proximal ligature of the subclavian artery in cases where compression has failed to effect a cure. 2. Mr. Syme³ speaks strongly in favour of the old operation; and in cases of rupture of the axillary artery, where no sac has formed, this is no doubt the best course to pursue. The subclavian artery must be commanded by the fingers of an assistant, for which purpose an incision may be made in the usual situation for the ligature of that vessel, and the artery be held firmly against the rib. Then the blood-tumour is to be opened in its whole extent, the clots removed, and both ends of the lacerated vessel tied. The same course may very properly be followed in a traumatic aneurism, particularly if the tumour has so far elevated the clavicle as to make the operation of tying the subclavian difficult and dangerous; but, as I have shown in another place, the relations of the sac to the artery and to the nerves of the plexus are very variable, and the surgeon may easily meet with very great difficulties. 3. Compression has been successfully applied to the third part of the subclavian artery;⁴ and though the difficulty of doing this is in some cases so great as to make it wellnigh impossible for the surgeon to do it, or for the patient to endure it, yet in others it will be found quite easy. These differences depend, of course, on the varying height to which the artery rises in the neck, the varying level at which the clavicle is found,⁵ and the varying thickness of the neck. In any case in which it seems at all feasible to make compression, and where the rapid growth of the tumour does not contra-indicate the attempt, I think the surgeon is bound to try this method of treatment before resorting to the ligature. Coles's Compressor, an apparatus constructed for the purpose, or the finger, may be used, according to the depth of the vessel.

Ligature
of the
subclavian
artery.

The subclavian artery may be tied in the third part of its course under ordinary circumstances with no great difficulty, though in complicated cases few operations are more embarrassing. The patient's head is to be turned to the opposite side—the affected shoulder is drawn downwards by an assistant as far as possible. The operator draws the skin of the neck down over the chest

¹ See Callender, in 'St. Bartholomew's Hospital Reports,' vol. ii. p. 96.

² See a paper by Mr. May, 'Lancet,' vol. ii. 1885, p. 612.

³ 'Med.-Chir. Trans.' vol. xliii. p. 137.

⁴ 'Lancet,' Sept. 27, 1873, p. 445. See also a case under Mr. Lund's care, 'Brit. Med. Journ.' May 4, 1878.

⁵ It may be worth while to notice that some surgeons believe with Mr. Spence that the clavicle is not merely pushed up passively by the size of the tumour in the axilla, but that its elevation is also, and perhaps chiefly, an active one, due to irritation of the nerves causing the muscles to contract and draw the scapula and clavicle upwards.

with the fingers of his left hand, and makes an incision on to the clavicle along its middle third. The skin is then released, and the incision lies about a finger's-breadth above the bone. In this way the surgeon avoids all risk of wounding the external jugular vein as it dips under the clavicle. This vein is next defined and drawn aside; or, if there is any difficulty in getting it out of the way, it is divided between two ligatures. The deep fascia is now opened to the extent of the skin-wound, and the cellular tissue of the subclavian triangle scratched through with the point of the director till the margin of the scalenus anticus muscle is plainly seen. In doing this the omo-hyoid muscle may be exposed, and possibly the transversalis colli artery may be met with. The surgeon now traces the scalenus anticus muscle down to its insertion into the first rib, and he will then find the artery lying close beneath his finger, emerging from behind the muscle, immediately behind the scalene tubercle. The nervous cord formed by the eighth cervical and first dorsal nerves lies

close above and behind the artery, and great care must be taken not to mistake it for the vessel, which may easily be done if from any cause the pulsation is not plainly perceptible in the artery or the parts cannot be brought into view. The needle should always be passed around the vessel from above, i.e. between the lowest cord of the brachial plexus and the vessel. The subclavian vein is so far below the clavicle that there is no chance of wounding it.

Sometimes, when the aneurism extends too far up the vessel to allow of the third part of the artery being safely tied, the second part has been secured. The operation is essentially the same, only a freer incision is desirable, which is obtained by notching the inner end of the skin-cut upwards, and by dividing the fibres of the sternomastoid as far as may be necessary to bring the scalenus anticus into view. When this has been done the fibres of that muscle are to be divided transversely on a director, with all possible care, to avoid injuring the phrenic nerve; and thus the artery is exposed. The surgeon must remember that on the right side the superior intercostal usually



FIG. 271. Ligature of the subclavian artery. At the inner angle of the incision the root of the external jugular vein is seen, and its course above is indicated through the skin. Some fibres of the sternomastoid muscle would also probably be seen in this situation. Deeper down is seen the scalenus anticus muscle going to be inserted into the first rib, and the artery emerging from behind it, with the nerves of the brachial plexus above and behind the vessel. Above these is seen the posterior belly of the omo-hyoid. The outer angle of the incision reaches to the trapezius muscle.

comes off from this part of the artery, so that it is very undesirable to tie the second part of the right artery; but if circumstances have rendered it inevitable, he should try and include the branch also in the ligature. The greatest care should be taken not to wound the pleura, which lies close below.

Ligature of the subclavian artery is a very formidable operation, about 45 per cent. of the cases operated on having proved fatal.¹

Aneurism
below the
axilla.

Spontaneous aneurisms below the axilla are extremely rare, though they are not unknown even in arteries so small as those of the hand; but I do not think it would answer any good purpose to speak in detail here of such rare cases. The main point to remember is, that spontaneous aneurism of these small vessels is very commonly associated with disease of the heart or general arterial degeneration, and ought not to be too actively treated.

The arteries of the upper extremity are, however, usually tied for wound, either at the part wounded, or, in the case of wounds of the palm, at a higher spot.

Ligature
of the
axillary.

The axillary is very rarely tied in the present day as a formal operation. In the dissecting-room it may be reached in any part of its course either by a free division of the pectoralis major (the precise line for which matters little, but which is generally effected by an incision convex inwards from the coracoid process to the edge of the anterior flap of the axilla), or the first part of the artery may be exposed by cutting asunder the clavicular and sternal portions of the pectoralis major and drawing them away from each other with strong double hooks, without dividing any muscular fibres. In the living subject, however, it would be much better to follow Guthrie's advice, by cutting freely through the anterior flap of the axilla and tracing the artery upwards to the point where the ligature is to be applied. The vein lies to the front and inner side of the artery, and the varying position of the median nerve must be recollected.

Ligature of
the
brachial.

The brachial is generally tied about its centre by an incision along the edge of the biceps, or, if that edge cannot be seen, in a line drawn from the middle point between the flaps of the axilla above to the middle of the bend of the elbow below. Possibly the basilic vein, or the internal cutaneous nerve, or even the ulnar nerve, may be seen in the first incision, and, if so, should be avoided. The deep fascia being opened, the edge of the biceps will be exposed, and, if the muscle is large, is to be drawn aside. Then the median nerve generally comes into view,² and must be gently displaced, and the artery picked up between its venæ comites. When the nerve crosses behind the artery the vessels will, of course, come into view at once.

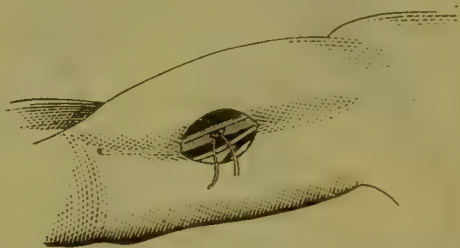


FIG. 272. Ligature of the brachial artery. The edge of the biceps is seen. The median nerve is shown in front of the artery. There are venæ comites on either side which are not shown. At the inner side and behind are seen the basilic vein and internal cutaneous nerve, but these structures are not generally exposed in the operation.

Ligature
of the
ulnar.

The ulnar may be tied at the upper part of the forearm, but this is very rarely necessary. Here it lies under the mass of muscles which arise from the inner condyle (except the flexor carpi ulnaris), and is crossed by the median nerve. The line of the vessel is from the middle of the bend of the elbow to the outer side of the pisiform bone. There are two ways of exposing it—either from above or below. In the former, an incision having been made over the course of the artery, the bicipital fascia is freely divided—the median nerve sought, the pronator teres freely cut through, and the vessel found below

¹ 'Of 94 cases where this artery has been tied for aneurism in the axilla, 51 have recovered and 43 have died.'—'Lancet,' Sept. 27, 1873, p. 444.

² This nerve crosses behind the artery about once in every four cases.

it. In the latter, the ulnar nerve is sought under the radial border of the flexor carpi ulnaris and traced till it is found joining its artery, which is then followed upwards, the muscles being successively divided till the point is reached where it is to be tied.

Far more commonly the artery is tied just above the wrist, between the tendon of the flexor carpi ulnaris and the ulnar tendon of the flexor sublimis digitorum. It is covered here, not only by the common deep fascia, but also by a special and strong, though thin aponeurosis. This having been divided, the artery will be found between its veins, and with the nerve on the inner side.

Similarly, the radial may be tied in the upper third of its course, but this is rarely necessary. It involves, however, no division of the muscles. An incision being made along the belly of the supinator longus, the artery and venæ comites come into view between that muscle and the pronator teres. The nerve is not here in contact with the vessels.

Ligature of the radial.

The common situation, however, for the ligature of the radial also is just above the wrist, where it may easily be found by dividing the deep fascia along the outer border of the flexor carpi radialis between that tendon and

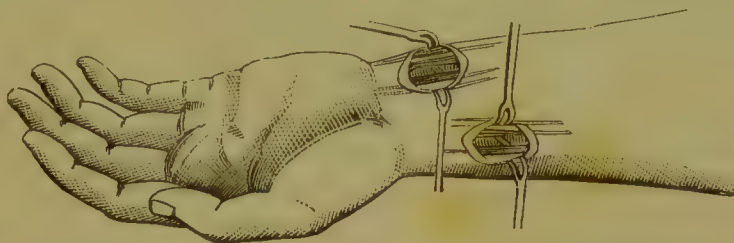


FIG. 273. Ligature of the ulnar and radial arteries. The upper figure illustrates the ligature of the ulnar. The upper double hook draws aside the tissues, exposing the tendon of the Fl. carpi ulnaris. The lower exposes the ulnar tendon of the Fl. subl. digitorum. The artery is seen with its nerve on the ulnar side, and the venæ comites on either side of it. The lower figure illustrates the ligature of the radial. The lower double hook exposes the tendon of the supinator longus, the upper that of the Fl. carpi radialis. Between them is seen the artery, having its venæ comites on the two sides. *Mem.*—In practice there is no necessity for exposing the tendons in this way.

the supinator longus. When the fascia is freely divided the artery and its veins come into view. Here also the nerve is not in contact with the vessels.

Abdominal aneurism affects either the abdominal aorta or one of the smaller arteries. Its diagnosis is not always easy. In the first place, the abdominal aorta itself sometimes pulsates so powerfully as to simulate aneurism, when no aneurism exists. This is most common in young women, and is sometimes called 'hysterical pulsation,' but is also not unusual in nervous men of relaxed fibre. It may be known from aneurism by the absence of any true aneurismal bruit (though some sound can often be elicited by pressure with the stethoscope, and sometimes in the vein as well as the artery), by the fact that the pulsation can be stopped by firm pressure with a single finger, if the patient can tolerate it; and, above all, by watching the case, when it will be seen to remain in the same condition for an indefinite period. Again, cancer connected with the bones of the spine or pelvis, and sometimes cancer of the lumbar glands, or even of the kidney, may pulsate, and thus simulate aneurism—as to which the reader must be referred to what has been said above (page 567).¹ And, on the other hand, abdominal aneurisms sometimes do not pulsate, and then their diagnosis becomes exceedingly obscure.²

Abdominal aneurism.

¹ Also to a paper in 'St. George's Hospital Reports,' vol. vii. p. 173.

² In examining a pulsating abdominal tumour it is important to note the pulsation in

When the diagnosis of aneurism is established it is not always easy to specify the artery affected; but this is perhaps of minor importance. Aneurism of the abdominal aorta produces pain in the back from pressure on the spine, weakness and pain in motion from the same cause, loss of nutrition, possibly from pressure on the thoracic duct or some of the lacteals, and vomiting or other disturbance of digestion from pressure on the stomach, intestines, or liver. It threatens death by rupture into the peritoneal cavity or into the cellular tissue. Aneurisms of the branches of the aorta (coeliac axis, superior mesenteric, &c.) produce much the same symptoms, and are distinguished from the aortic aneurisms chiefly by their position, and those of the superior mesenteric by their mobility, which is sometimes very great, as well as by the way in which the bruit can sometimes be traced upwards into the aorta.¹ Aneurism of the common iliac is rare, but when it occurs it can generally be known by its situation, and by the definite limitation of the symptoms to one side of the body. When the external iliac artery is affected there is not usually any difficulty in determining the fact, though it may not be easy to decide how high the tumour extends.

The treatment of aneurism of the abdominal aorta must as a general rule be restricted to rest and medical measures only; but some of the aneurisms which affect the lowest part of the vessel may be under the influence of pressure applied to the artery as it lies on the spine just above the origin of the inferior mesenteric. Some surgeons believe in the possibility of compressing even a higher part of the artery than this, where it lies between the pillars of the diaphragm. This bold attempt was first made, and with success, by Dr. Murray of Newcastle, in the year 1864.² His patient was cured temporarily, but a higher part of the aorta became aneurismal, and he died six years after. Post-mortem examination proved that the aneurism had really affected the lowest part of the aorta itself. Several other abdominal aneurisms have been cured by pressure under chloroform, and in some of them the aorta is believed to have been the artery affected, though in no other, as far as I know, has definite anatomical proof of the fact been obtained. And the operation is now a recognised surgical proceeding very far superior to the ligature of the aorta (which has proved uniformly fatal), or even to that of the common iliac, from which only one-fourth of the patients have recovered. It has, however, its own dangers, and they are by no means small. These dangers arise from the protracted anæsthesia, and from the risk of contusing the viscera (the intestines, the mesentery, the pancreas, and the kidney have all been found to have been injured), or of embarrassing the action of the heart, or injuring the great sympathetic ganglia and nerves. Several deaths have occurred from these causes, and in several cases the compression has failed to effect a cure; but it is a most valuable remedy, and has often also been used in the treatment of aneurism of the external iliac, the common iliac being then usually selected for pressure. The patient's bowels ought to be in different positions. The hand is applied to the pulsating tumour when the patient is in the recumbent position, and he is then directed to turn over slowly until he gets into the prone attitude, while the surgeon carefully notes the variation, if any, of the pulsation. Persistent pulsation in all positions indicates aneurism of, or a tumour intimately connected with, the aorta; diminished pulsation in the prone position points to aneurism of the coeliac axis, or of some other vessel lying in front of the aorta. Entire cessation or marked enfeeblement of pulsation is characteristic of a tumour in no way connected with the great vessel. See Dr. Archer, '*Brit. Med. Journ.*' March 8, 1879; and Moore, '*Dublin Quarterly Journal*,' August 1869.

¹ See a case under Mr. Pollock's care, reported in the '*Clin. Soc. Trans.*' vol. vii. p. 58.

² '*Med.-Chir. Trans.*' vol. xlvii. p. 187. See also '*Lancet*,' Feb. 8, 1873.

be well unloaded, and the parietes of the belly relaxed by bending the body. He should be placed fully under the anæsthetic, and the tourniquet should then be screwed down. If the aorta is to be compressed, the pulsation in the aneurism and in both femorals must be completely abolished; if the common or external iliac, in one femoral only. It is well to maintain the temperature of the limbs by swathing in wool. Some surgeons apply distal pressure also below the aneurism, but its benefit is doubtful. The pulse and respiration should be carefully observed by the chloroformist, while the surgeon and his assistants manipulate the tourniquet and attend to the pulsation. The anæsthesia need not be at all deep, and has been continued for many hours in some cases without serious danger.

Whether the abdominal aorta should ever again be tied is a matter of opinion. My own is that, as the operation has been practised at least eight times, and never with success, the patient has a better prospect from rest and medical treatment. But the operation on the common iliac is undoubtedly justifiable. There are two different ways of performing it. In one of these—Sir P. Crampton's method¹—the artery was sought from behind by an incision made 'from the end of the last rib obliquely forwards and downwards to the crista ilii, and then curved forwards above and parallel to the crest of the ilium, terminating at the anterior superior spine. The muscles and fascia transversalis were cut through at the bottom of the incision till the subperitoneal interval was reached, and then—the peritoneum being held back by the front of the finger—a probe-pointed bistoury was run along the back of the finger, and so, by repeated strokes of the bistoury, the muscles were divided to the extent of the external wound. Sufficient room was obtained to pass in the whole hand and raise the peritoneum and intestines from the fascia iliaca. The parts were then plainly visible, and the vessel easily secured.'

Ligature of
the abdo-
minal aorta
and of the
iliac
arteries.

The other method of securing the common iliac artery is from the front, and this operation is essentially the same, whether the operator wishes to secure the aorta, the common, the internal, or the upper part of the external iliac artery. An incision is made through the abdominal parietes, the extent of which varies according to the height which the operator wishes to attain. It commences below, just external to the internal abdominal ring, runs outwards somewhat parallel to Poupart's ligament, and then curves inwards towards the umbilicus. If the common iliac or the aorta is to be tied the incision should not be less than six inches in length. The three abdominal muscles having been divided, and the fascia transversalis incised along the whole extent of the wound, the peritoneum, containing the intestines, is to be gently separated from the abdominal wall until the iliac vessels are found. They must then be traced upwards as far as necessary, their relations being attentively borne in mind. If the aorta is to be secured the main point is to separate it from the cellular tissue which forms its sheath, and from the vena cava, without any injury to the latter or to the parts in front, in which the great lymphatic vessels and the commencement of the receptaculum chyli might be wounded. The right common iliac artery is in relation with three veins—the vena cava lies on the right side of its upper part, the right common iliac vein on its right side below, and the left common iliac crosses behind it to join its fellow of the opposite side. The left common iliac vein lies behind and internal to its artery. The ureter

¹ 'Med.-Chir. Trans.' vol. xvi. p. 102.

crosses over the bifurcation of the common iliac, or the upper part of the external iliac artery, and the spermatic vessels pursue their course upwards in front of the external iliac artery; but both these structures are generally so adherent to the peritoneum that in raising that membrane the surgeon pushes them away from the artery. The external iliac vein lies on the inner side of the artery, inclining on the left side more to its deep surface, and in tying the external iliac the genito-crural nerve, which runs down on its surface, should be looked for and avoided. In tying the lower end of the external iliac artery less extensive incisions are required. Mr. Abernethy, in his original operation (the first in which this artery was tied),¹ made the incision upwards and inwards from the centre of Poupart's ligament along the course of the artery. But this operation has now fallen out of use. The objection to it is that it gives little room, and is not available, if the operator finds it necessary to go higher than he at first intended. The lower part of the external iliac artery can, however, be easily reached by an incision parallel to and a little above the outer half of Poupart's ligament, by just pushing up the lower part of the peritoneum, and this is the plan now in common use. If more room is required it can be easily got by extending the outer end of the incision upwards and inwards. The peritoneum and intestines having been gently pressed to the other side till the finger is about to pass into the true pelvis, the artery will be met with lying on the brim of that cavity. It must be carefully separated from its vein, and the ligature passed from within outwards, care being taken not to include the genito-crural nerve.

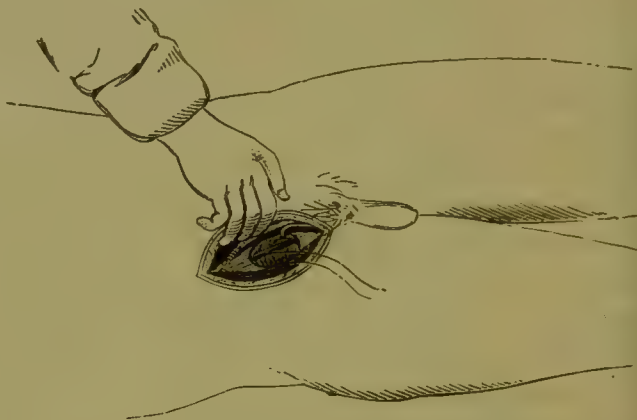


FIG. 274. Ligature of the external iliac artery. The assistant's hand is shown pushing back the intestines, covered with peritoneum. The two ends of the ligature are seen passing in between the artery which is external, and the vein on the inner side, a large part of the sheath having been cut away to show the vessels. Towards the internal ring will be seen the white end of the vas deferens dipping into the pelvis, and the spermatic vessels lying on the peritoneum.

The internal iliac is found either by tracing the common iliac downwards, or the external upwards, till the bifurcation is reached, and then passing the finger down the artery into the pelvis, and scratching it clean with the finger-nail and director, so as to get the ligature round it about an inch from its origin if possible. The great depth of the vessel renders a very free incision necessary, and there is often much difficulty in getting the ligature round the artery, though Mr. Syme's case shows that this may be done with the ordinary aneurism-needle.²

Gluteal aneurism.

Gluteal aneurism is a rare disease, and one with which, therefore, no surgeon is sufficiently familiar to speak with much decision as to its treatment. It is very commonly traumatic, either from direct perforation of the artery by a stab, or from an injury in which the vessel is contused against

¹ See a lecture in the 'Lancet,' Aug. 29, 1874, for a summary account of the early operations on this artery.

² Syme, 'Observations in Clinical Surgery,' p. 168.

the bone. The artery affected may be either the gluteal or sciatic, or even the internal pudic, as it crosses the spine of the ischium, as in a preparation of John Hunter's in the College of Surgeons' Museum. In wounds the smaller arteries, branches of the gluteal or sciatic, may be implicated. The symptoms are not always obvious. In traumatic aneurism (so called) there may have been no sac, or in this, as well as in spontaneous aneurism, the sac may have given way, and so there may be no pulsation;¹ and many such tumours have been opened by mistake for abscess, usually with a fatal result. Such a disaster would probably be avoided by auscultation, for it is certain that in many, if not all, such cases a bruit would be audible. Gluteal aneurism is not necessarily fatal. Indubitable cases of spontaneous cure are recorded, and in other cases the disease has long remained stationary. But when the pressure of the tumour on the nerves causes much distress, or when the size of the aneurism is increasing, and it threatens soon to burst, surgical treatment is necessary; but it is not easy, in the present state of our knowledge, to say what is on the whole the most promising method of treatment. In recent wounds, and in those cases of traumatic aneurism which most nearly approach to the character of recent wounds, the best plan is to lay the sac freely open and tie the artery. Hæmorrhage may be controlled during this operation either by plugging the sac with the fingers, on Mr. Syme's plan, or by pressure on the aorta by Lister's tourniquet, or by compression made from the rectum.² Many cases, I have no doubt, might be cured by compression of the aorta or common iliac under chloroform. Dr. Sands has published in the 'Am. Journ. Med. Sci.' April 1881, a very interesting case in which prolonged digital compression of the internal iliac artery from the rectum was made, but without success in curing the aneurism, though the circulation was completely controlled. Some cases have been treated successfully with coagulating injections,³ and galvanopuncture may very fairly be tried in these cases, or manipulation. In cases where the opening in the artery is situated inside the pelvis—a fact which can often be ascertained by examination from the rectum, and which is extremely probable in spontaneous aneurism—the surgeon will probably think it better, on the failure of compression, to resort to the ligature of the internal iliac artery—an operation, however, which is so very dangerous from its anatomical difficulties, as well as from the risk of finding the artery diseased, that it should be avoided as much as possible.

For many details on the diagnosis and treatment of gluteal aneurism, for which my present work affords no space, I would refer to a lecture published in the 'Lancet,' July 11, 1874.

Aneurism of the femoral artery is met with either in the groin, affecting the common femoral (inguinal aneurism), or in the lower part of Scarpa's

Femoral
aneurism.

¹ The student must always remember that the pulsation of an aneurism depends on the reaction of the sac upon the blood which distends it, so that a free rupture of the sac involves loss of pulsation.

² A very interesting and successful case of ligature of the gluteal for traumatic aneurism by laying open the sac, under the care of Dr. Thorndike of Boston, U.S., will be found in the 2nd series of the 'Med. and Surg. Rep.' of the Boston City Hospital, p. 219. In the latest published case (Turner, 'Clin. Soc. Trans.' vol. xvii. p. 172) the gluteal artery was easily secured, hæmorrhage being controlled by Davy's lever. All connected with the operation went well, but the patient died of tetanus.

³ Compression of the aorta would, of course, be employed during the injection of the coagulating fluid.

triangle, affecting the superficial femoral, and often spreading down into the popliteal space—femoro-popliteal aneurism—or in some intermediate situation; and here the common or the superficial femoral may be implicated, according to the level at which the profunda arises, which in the living subject can hardly be determined;¹ or the profunda itself,² or even one of the secondary branches, as the external circumflex,³ may be the seat of the aneurism.

As a rule, aneurisms in the thigh, when they occur in a tolerably healthy subject, and the sac is perfect, are best treated by pressure on the femoral in the groin. This pressure is, I think, equally indicated in aneurism of the common and superficial femoral, or in the rare cases where the profunda or other smaller branches are affected. For although in aneurism situated low down in the thigh it might on other grounds seem desirable to put pressure on the superficial or on the lower part of the common femoral, yet these arteries are so much more deeply placed, and their compression is so much more painful, that in practice it is found much easier to cure the disease by pressure in the groin. Digital pressure is, I have no doubt, far superior to any other form in this situation, though the artery is so easily compressed that any other form of pressure can be used; and cases have been treated successfully by the pressure of a weight, suspended from a frame or cradle, or by various forms of tourniquet.

In ilio-femoral aneurism it may be necessary to make instrumental pressure under chloroform on the aorta or common iliac, as above described; and in some cases of aneurism which are either entirely femoral or only affect the very end of the external iliac artery, the latter vessel might be compressed, though, as a general rule, it would be more prudent to select the higher artery, so as to avoid all risk of compressing the aneurismal tumour, which might easily occasion inflammation and rupture of the sac.

There are, no doubt, many cases of uncomplicated inguinal aneurism which may be cured by compression, and a series of cases in which success was obtained by rapid pressure under chloroform will be found in the 'Lancet' (Oct. 10, 1874). But pressure often produces unfavourable symptoms. I would allude to a paper by Mr. Walsham,⁴ in which reference is made to thirty-seven published cases where pressure was used, and of which only ten were cured, while death in four cases seemed directly caused by the pressure; and to a case of my own, in the tenth vol. of the St. George's Hospital Reports, in which gangrene of the leg came on, apparently as the result of pressure. In all cases, then, of rapid growth of the tumour, or where any complication exists, I should recommend the immediate recourse to the ligature, and in any case I should not persevere with pressure unless it produces undeniable and immediate benefit. If the common femoral be affected the external iliac artery must be tied, and in ilio-femoral aneurism the surgeon may even find himself obliged to operate on the common iliac. In

¹ I would refer to a case described by Sir Prescott Hewett ('Med.-Chir. Trans.' vol. xxix. p. 75), under Sir B. Brodie's care, in which the external iliac was tied, and which is figured on p. 574. Before dissection this was believed to be an aneurism of the common femoral. After death it was found that the profunda came off rather high, and that the aneurism really sprang from the commencement of the superficial femoral.

² Several instances of aneurism of the profunda may be found quoted in a lecture published in the 'Lancet,' Oct. 17, 1874, under the care of Erichsen, Cock, and P. H. Watson.

³ An aneurism occurring spontaneously in the external circumflex artery is recorded by M. Letenneur of Nantes in the 'Bulletin de la Soc. de Chir.' 1856.

⁴ 'Clin. Soc. Trans.' vol. xviii. p. 254.

a case under the care of Dr. G. Buchanan of Glasgow ('Brit. Med. Journ.' Dec. 4, 1880) that surgeon was so impressed by recurrence of pulsation after simple ligature of the external iliac (as happened in Sir. B. Brodie's case, figured on p. 574), that he tied also the superficial femoral and the profunda below the aneurism, and laid open the sac—in fact, performed the old operation.

In aneurism implicating the lower part of the common or the superficial femoral or profunda arteries, the question has arisen whether the common femoral artery might not be secured. The general rule has been that if the aneurism extends too high up to enable the surgeon to secure the superficial femoral artery the external iliac should be tied, since it was taught that the ligature of the common femoral in the groin, though a very easy, was a peculiarly fatal operation—so much so that some good surgeons have gone so far as to say that the operation ought to be banished from practice.¹ But I cannot discover on what data this opinion is founded. The Irish surgeons,

Ligature
of the
common
femoral.

following on the example of the elder Porter, have practised this operation tolerably often, and their experience of it has been pretty satisfactory,² and Dr. Mott also highly recommends it, and says he has often performed it with success.³ My own impression is that the operation is less dangerous than the ligature of the external iliac artery, though much more so than that of the superficial femoral. A longitudinal or oblique incision is made over the course of the artery; any glands which lie in front of the sheath are to be drawn aside, as well as the crural branch of the genito-crural, or a branch of the anterior crural nerve, which may come into view; and, the sheath being opened about an inch below Poupart's ligament, the ligature is to be carried round the artery from the inner side.



FIG. 275. Ligature of the superficial femoral artery. Two double hooks are shown, one of which draws the edge of the sartorius muscle outwards or downwards, the other exposes the fibres of the adductor longus running in the opposite direction. A large piece has been cut out of the sheath, to show the artery with the ligature round it, and internal to and below it the vein, indistinctly seen. A nerve is seen on the outer and front aspect of the sheath, a branch of the anterior crural. This is sometimes the saphenous; at others, where the artery is exposed a little higher, one of the cutaneous nerves.

The ligature of the superficial femoral (which is the operation usually intended when tying 'the femoral artery' is spoken of) is the most familiar, and by far the most successful, of all the operations on the arteries. The spot which is selected for tying the vessel is just above the margin of the sartorius, at the apex of Scarpa's triangle, i.e. at the junction of the upper

Ligature
of the
superficial
femoral
artery.

¹ Erichsen, 'Sc. and Art of Surg.' 5th ed. vol. ii. p. 110. Mr. Erichsen, however, in his later editions, though he does not approve of the operation, speaks of it in terms of much less sweeping condemnation.

² Out of nine cases three died—one from hæmorrhage previous to operation (this case should be omitted from the list), one with diseased arteries from secondary hæmorrhage, and another in whom there was a high bifurcation and the ligature was placed close below the profunda, also of secondary hæmorrhage. The last is the only case which can really be said to have died in consequence of the kind of operation selected.

³ See also other cases quoted in the 'Lancet' for Aug. 29, 1874.

and middle third of the thigh. If, from œdema or other causes, the edge of the sartorius cannot be made out, a line from a point midway between the anterior superior spine of the ilium and the symphysis pubis to the most prominent point of the internal condyle of the femur, with the leg flexed and the thigh rotated outwards, will mark the course of the vessel. The skin and fasciæ having been divided to the extent which the size of the patient requires (three inches may be taken as a moderate incision), the edge of the sartorius is sought for, and the muscle having been drawn a little outwards, the sheath is found, with a small nerve usually lying on it—the long muscular branch from the anterior crural. The long saphenous nerve generally does not join the artery till lower down. The sheath is to be carefully opened over the front of the artery. When the white coat of the vessel is fully brought into view it should be gently scratched clean with the point of the director, and the aneurism-needle passed round it from the inner side. Great care should be used neither to expose the artery to an unnecessary extent nor to contuse the vein. In fact, it is more satisfactory never to have touched or seen the vein.

The anomalies in the course of the artery are so very rare that it is hardly worth while to do more than just to mention that in one case Sir C. Bell found that the femoral artery had a large ‘*vas aberrans*,’ which, given off from a higher source, joined the main trunk above the aneurismal tumour, and carried on the circulation in it after the artery had been tied; and that cases have been dissected in which the sciatic artery furnishes a large branch—‘*femoro-popliteal*’—which runs down the back of the limb into the popliteal space, while the superficial femoral artery is deficient, or is represented only by a small branch which terminates as the *anastomotica magna*.¹

The femoral artery may also be tied in Hunter’s canal, as Hunter originally did. This, however, can only be done in popliteal aneurism, not in femoral, and is only resorted to after the failure of the operation in Scarpa’s triangle. The point at which Hunter tied the artery in his earlier cases was midway between the groin and the knee, and this is the position usually selected. A free incision must be made in the line of the artery, so that its centre corresponds to this point. After the deep fascia has been divided the sartorius will be exposed, and its outer border, which will correspond with the incision in this situation, sought for. This is to be drawn inwards, and the fascia covering the canal will be exposed, and is to be laid open; the artery is sought with the long saphenous nerve lying usually in front of it and within the sheath. This should be carefully avoided, as well as the vein.

Popliteal
aneurism.

Popliteal aneurism is the form by far the most familiar to surgeons; and it is satisfactory to know that the treatment of this disease—a disease so formidable in the times before Hunter that Mr. Pott expressed, in the most decided terms, his preference for amputation over the treatment then in vogue—has now become so successful that out of 212 cases admitted into various metropolitan and provincial hospitals, chiefly during the ten years 1861–70, and reported to me from those hospitals, 166 were cured entirely and permanently by ligature or pressure (and a few by less common means), 12 were cured after amputation, in four the disease was not cured, and 29 died.² This is a list formed entirely of unselected and common cases just as

¹ Dr. Hilton Fagge, in ‘*Guy’s Hospital Reports*,’ 3rd ser. vol. x. 1864.

² ‘*Lancet*,’ May 1, 1875.

they presented themselves at the various hospitals, containing, of course, a percentage of complicated and advanced cases which were, probably, in themselves incurable. The cases were under the care of surgeons of very various degrees of experience and operative skill. In fact, it seems to me to represent in all ways the average of success and failure which the surgeons of the present day have met with in the treatment of popliteal aneurism. And this average of success, large as it is, will, there is no doubt, be largely increased by the improved methods of compression recently introduced, and by the increasing intelligence of the labouring population, and their diminished fear of surgical treatment, leading them to apply earlier for advice.

Again, I think that I have shown (in the lectures above referred to) that the mortality after the Hunterian operation on the femoral artery has been greatly diminished; as has also been the prevalence of gangrene, secondary hæmorrhage, and other untoward but not necessarily fatal complications, in modern practice, in all probability as a consequence of the more careful method of operating, and simpler treatment after operation, which distinguish modern surgery; so that the mortality, which in 188 published cases tabulated by Norris¹ was 24·46 per cent., was only 14·94 per cent. in 87 similar² (published and unpublished) cases contained in the list above referred to. These facts, which, I think, can hardly be gainsaid, are most encouraging to a surgeon in undertaking the care of a case of popliteal aneurism. There remains the question, What class of cases are adapted for the ligature, what for compression, and what for flexion? And after compression or flexion has been attempted, how long should the attempt be persisted in if not at once successful?

I may, perhaps, add that, though cases are on record in which cure has been obtained by some of the less usual proceedings—such as manipulation, coagulating injections, Esmarch's Bandage, &c.—it seems to me, speaking generally, that such proceedings are so far more dangerous and so far less likely to succeed than the known and familiar resources of surgery, ligature, and pressure, that I think it useless to spend time on their discussion here.³

In discussing the treatment of popliteal aneurism it is well to study the symptoms and the anatomy of various specimens of it. The first thing that strikes us is the difference in the relation of the sac to the artery. Some aneurisms grow from the anterior face of the vessel towards the knee-joint. These are marked by a distinct line of pulsation in the course of the artery lying over and distinguished from the general pulsation of the tumour, and by the readiness with which the joint becomes inflamed. The more common form (as it seems) grows from the back, or partly from the side, of the artery, and is marked by the absence of any such distinct line of pulsation, and by the early implication of the nerve, leading to pain shooting down the limb, and, by pressure on the vein, causing œdema and weight of the leg and foot.

My own impression is that aneurisms on the anterior face of the artery are rarely cured by any measure short of the ligature; and even the latter often fails and amputation becomes necessary.⁴

¹ See Norris's 'Contributions to Surgery.'

² By similar cases I mean cases in which the femoral artery was tied, as in those tabulated by Norris, without the previous use of compression.

³ As to the use of Esmarch's Bandage, however, in some exceptional cases, see p. 578.

⁴ See two cases related by Tufnell on 'Aneurism,' pp. 120-130; and see also a lecture in the 'Lancet,' Dec. 12, 1874.

Again, the progress of the case has a most important influence on the treatment to be adopted. In an aneurism which is extending rapidly, and of which the sac is therefore thin and probably imperfect in parts, it seems more prudent to resort to the ligature at once; and generally in all the severer cases, and in those where the tumour has already burst, but where the surgeon does not think it necessary to amputate at once, the ligature is probably the safest course.¹

Genu-
flexion.

Flexion is indicated in small aneurisms, situated on the posterior or lateral aspect of the artery, in which the pulsation and bruit are suspended by bending the knee. It need not be extreme nor painful, nor need the limb be bandaged or confined in any way, at least in many cases. Voluntary flexion, in which the patient is allowed to change the position of the limb slightly, will succeed in many cases, and will be tolerated where forced flexion would produce pain and would be given up. Besides, forced flexion has been known to produce rupture of the sac, which voluntary flexion hardly could do. Flexion seems to act partly by retarding the blood-stream, partly by direct pressure, and probably also by displacement of clot. It may easily be combined with digital or instrumental pressure.

When pressure or flexion, either alone or in combination, is to succeed, a perceptible amelioration of the symptoms is generally noticed at once, i.e. in the course of the first two or three days. If this is not the case it becomes a very important question how long the attempt should be continued. Relying on the doctrine that if pressure failed to cure the aneurism it would produce at any rate some benefit by causing dilatation of the anastomosing vessels and thus diminishing the risk of gangrene, and influenced also by the published statistics of ligature of the femoral artery—which, I think, I have shown to be more unfavourable than the results of modern practice justify—many surgeons were in favour of persevering with pressure for a very considerable length of time; and it is not to be denied that in many cases a cure has been so obtained,² but at the expense of an amount of suffering to which few persons would willingly submit unless in order to avoid some very great danger. And, as it seems, it is very problematical whether the danger is not the other way. Certainly the mortality after ligature of the femoral artery appears not to be diminished, but, on the contrary, increased, by the previous unsuccessful trial of compression;³ and, on the whole, I have been led to the conclusion that if no considerable improvement has been effected by the bloodless method in the first week, it is better to give up the attempt, allow the patient a few days to recover from the distress which the compression has probably caused, and then tie the artery.

In making compression I have myself no doubt whatever of the superiority of the digital over all other forms of pressure, if carefully employed; and I think the observation of Mr. Walker an important one, that the pressure should not be varied from the common to the superficial femoral and

¹ Cases of successful ligature after the rupture of the aneurism may be found recorded in the 'Brit. Med. Journ.' 1859, p. 479 (where the aneurism had burst into the knee-joint); and one in the 'Lancet,' 1851, vol. ii. p. 30, where the aneurism (femoral) had burst through the skin. A case in which the femoral was tied with success after the rupture of the aneurism occurred a few years since under Mr. Stirling's care at St. George's Hospital.

² See a remarkable instance of resolute persistence on the part of the surgeon and of the patient for the space of half a year, after which a cure was at length obtained, recorded by Mr. Walker of Liverpool.—'Liverpool Hospital Reports,' vol. v.

³ 'Lancet,' May 1, 1875.

vice versa, but should be applied to the same vessel throughout ('the one-artery system,' as he calls it), so that the same collaterals should always be called upon.

With regard to the question as to the position on the artery to which the ligature should be applied, Professor Annandale has recently advised that in certain cases of popliteal aneurism, such as large aneurisms filling up the space and causing injurious results from pressure, in rapidly growing aneurisms, in cases of general arterial disease, in aneurisms which have involved the knee-joint from pressure, and some other cases, recourse should be had to the 'old method' instead of the Hunterian operation. The advantages which he claims for this operation are a certain and speedy cure, and obliteration of the sac, provided all goes well, and the immediate removal of the large tumour, which by pressing on the veins, and probably also upon the arteries, interferes with the proper circulation of the limb; so that in this way two of the principal risks—gangrene of the limb and suppuration of the sac—are in great part done away with.¹

Aneurism occurs below the popliteal space, but almost always from traumatic causes, or in cases of extensive disease of the heart and arteries.² Traumatic aneurisms of small arteries are best treated as recent wounds; and in the present day the use of Esmarch's Bandage enables the surgeon to exclude the blood completely from the tumour while he dissects out the vessels and ties them as easily as on the dead subject. Aneurisms the result of cardiac or general arterial disease are best let alone or treated by the mildest forms of compression. They are usually not in themselves very dangerous, and the patient's life cannot in any case be a long one. For these reasons operations on the tibial arteries, other than their direct ligature for wound, are amongst the rarest operations in surgery. In some very rare cases, however, one of the tibial arteries has been wounded from the other side of the leg by a stab through the interosseous membrane, and then it has been necessary to cut down formally on the artery according to the rules of the dissecting-room.

Ligature of
tibial
arteries.

The posterior tibial can be secured near the ankle with facility, as it lies between the tendons of the *tibialis posticus* and *flexor longus digitorum* in its inner, and that of the *flexor longus pollicis* at its outer side. All that is necessary is to make an incision half-way between the internal malleolus and the heel and dissect the parts.

To secure the vessel higher up two different plans are adopted. Mr. Guthrie's has the advantage of enabling the surgeon to secure the peroneal artery, if his diagnosis should prove at fault and the wound or other lesion should implicate that vessel and not the tibial. A vertical incision is made in the centre of the calf about six inches long, through the *gastrocnemius* and *soleus* muscles, the deep or intermuscular fascia freely divided, and the vessel sought immediately beneath this fascia superficial to the *tibialis posticus* muscle.

¹ 'Edinburgh Medical Journal,' Feb. 1886, p. 717. On this subject see also a paper by Mr. Savory, above referred to (p. 573). 'Med.-Chir. Trans.' vol. lxx. p. 139.

² See, however, a paper by Mr. W. Edmunds in the 68th vol. of the 'Med.-Chir. Trans.' on a case of spontaneous aneurism (partaking of the cirroid nature) of the *dorsalis pedis* artery, cured by excision. In this paper reference is made to six cases of spontaneous aneurism in this situation. This list does not, I think, include one to which I referred in my lectures at the College of Surgeons. I would also refer to a paper by Dr. Delonne, 'Gaz. Heb.' Feb. 28, 1879.

The old method of tying the posterior tibial is to make an incision parallel to the posterior border of the tibia, and about a finger's-breadth behind it through the skin, superficial and deep fascia, exposing the tibial origin of the soleus muscle. This is then cut from the bone, the intermuscular fascia is opened, and the artery found, with a vein on either side of it, and the nerve probably superficial to it. The artery is then separated from these structures and tied.

The anterior tibial artery will be found in any part of its course by an incision in a line drawn from the head of the fibula to the central point



FIG. 276. Ligature of posterior tibial artery. The posterior hook draws aside the deep mass of muscles and the intermuscular fascia. The vessels and posterior tibial nerve are seen lying on the tibialis posterior.

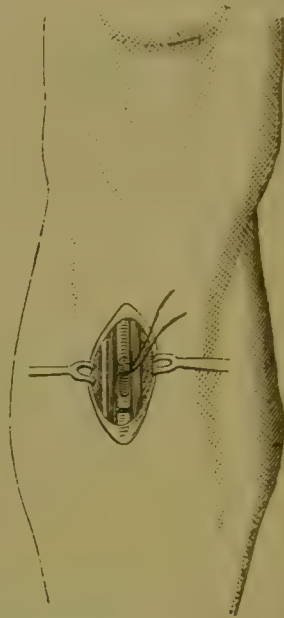


FIG. 277. Ligature of anterior tibial artery. The vessels are seen with the nerve lying in front and to the outer side.

between the two malleoli. At the upper part of the leg it lies very deeply, at the outer edge of the tibialis anticus muscle, in the septum of the fascia, which shows as a white line, separating that muscle from the extensor long. dig. above and the ext. prop. pollicis in the middle of the leg. Success in this operation depends on hitting the edge of the tibialis anticus, for which purpose the surest way is to get the patient to put it into action before he is placed under anæsthesia and mark it out, and to make the incision very freely, and carefully search for the white line before opening the fascia. The artery has venæ comites on either side, and the nerve external or superficial to it.

CHAPTER XXIX.

DISEASES OF THE VEINS AND ABSORBENTS.

THE leading symptom of phlebitis, or inflammation of veins, is the occurrence of coagulation in them, as evinced by hardness along the course of the vein. In true inflammation this is accompanied by pain and redness, and some amount of general fever. The mere coagulation of the blood in the veins by no means implies any inflammation, or any general affection of the system, or even any alteration in the tissues of the vein itself. Such passive coagulation of the blood in the veins used to be denominated 'adhesive phlebitis,' on the theory that the cause of the coagulation was effusion of lymph from the lining membrane of the vein; but it has been satisfactorily shown, both by clinical and anatomical observation, that in many of these cases there is no evidence of any inflammation whatever; and the direct experiments of Guthrie, Travers, H. Lee, and Callender in our own country, besides foreign observers, have shown that the lining membrane of the veins does not secrete lymph. Consequently the condition known to the older pathologists as 'adhesive phlebitis' is now usually designated more correctly as 'thrombosis.'

The causes which lead to thrombosis are very numerous, but may be classified under three heads: (1) Alterations in the integrity of the coats of the vein. (2) Alterations in the constitution of the blood. (3) Slowing or arrest in the blood-current. Thrombosis.

(1.) Any alteration or change in the walls of the vein, especially anything which conduces to a diminished vitality of the part, is a potent cause of coagulation; thus injury, inflammation, or degeneration of the coats of the vein, by diminishing their vitality, causes them to act as a foreign body in regard to the blood and induce it to coagulate. (2) The alterations in the constitution of the blood which predispose to thrombosis are not very well understood, but are believed to be due to the setting free of 'fibrin ferment' by the disintegration of leucocytes. In certain diseases, such as pyæmia and septicæmia, in which thrombosis is very common, there is known to be a considerable disintegration of white corpuscles; and it is believed that under these circumstances coagulation is induced by the fibrin ferment which is set free during the process. Again, other alterations in the constitution of the blood are believed to be due to excess of excrementitious matters from defective elimination, as in gout. (3) Slowing or arrest in the blood-current may lead to thrombosis. This may arise from retardation of the blood-stream; from a weakened action of the heart, as in old age, or exhaustion after fever or loss of blood; from loss of *vis-à-tergo* in cases where the supplying artery has been ligatured or injured; from pressure of a tumour on the vein; or from division of the vein in surgical operation or otherwise.

When a thrombus forms slowly and there is still a certain amount of circulation through the vessel, the clot which is formed is of a grey colour, and is known as a *white thrombus*; whilst when the blood is entirely at rest it coagulates rapidly and red corpuscles are enclosed in its meshes, producing a clot of a red colour, the *red thrombus*. In the majority of cases, however, Varieties of thrombi.

the coagula are of a variable or mottled colour, almost black in some places, in others nearly decolourised. This is known as a *mixed thrombus*.

The changes which may take place in a thrombus are several, and vary according to the causes which led to its formation and to the circumstances under which it may be placed: (1) The most common fate of a thrombus is *absorption*. This is brought about in most instances by a gradual softening or disintegration commencing in the centre of the clot, and gradually extending to the periphery. The products of the disintegration are removed as soon as they liquefy, and the débris thus formed, being non-infective in character, is carried away in the circulation and gives rise to no symptoms. In this way the lumen of the vessel is gradually restored, though after absorption is complete, staining of the intima may persist for some time. (2) Occasionally a clot in a vein, or a portion of it, may calcify. This generally occurs in cases of varicose veins, where pouches are formed behind the valves, in which thrombosis occurs. The clot in the pouch then undergoes calcification, and forms small calcareous masses called *phlebolithes*, consisting principally of phosphate of lime, with some small quantities of sulphate of lime and potash, mixed with organic matter. (3) *Thrombi* may become *organised*. The clot undergoes changes which end in its organisation, the exact nature of which are not as yet completely determined. According to Cornil and Ranvier, the clot sets up irritation; this induces a proliferation of the endothelial cells lining the vessel, which, as the thrombus is gradually absorbed, fill up the lumen of the vein and form a connective tissue, and becoming vascular, permanently obliterate the vessel.¹ Others believe that the fibrin of the clot itself fibrillates and forms the connective tissue. In whichever way originating, the connective tissue thus formed undergoes cicatricial contraction, and, blending with the coats of the vein, forms a fibro-cellular cord. (4) Disintegration, or yellow 'puriform softening,' occurs in septic thrombi and in thrombi in veins attacked with septic inflammation. It is a grave condition and leads to serious results. The clot breaks down into a creamy fluid, resembling pus in appearance, consisting of granular débris, some pus-cells, or cells resembling pus-cells, and containing a large number of micrococci. (5) Finally, a portion, or the whole, of the clot may become detached and carried by the circulation through the right side of the heart to the pulmonary arteries, in one of which it becomes lodged, constituting pulmonary embolism. This may arise from purely mechanical causes, from a portion of clot extending beyond the next branch and being broken off by the impact of blood (Fig. 278), or by careless handling, or some movement on the part of the patient. It is, however, more commonly the result of softening and disintegration of the clot.

The symptoms of thrombosis are œdema of the part from which the vein affected derives its tributaries, with a hard cord-like swelling in the course

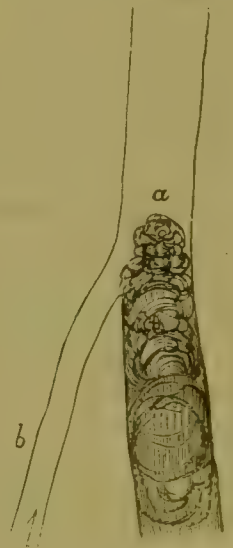


FIG. 278. Diagram of a thrombus in a vein. From Billroth. *a*. Central end of a venous thrombus projecting into a large trunk. *b*. A branch without thrombus: the blood flowing through it may detach and carry into the circulation the end of the thrombus *a*.

¹ See page 100, on the organisation of thrombi in arteries.

of the vein. Whenever there is local œdema—that is to say, œdema of one part, say one extremity, without any œdema elsewhere—thrombosis should always be suspected, and if this is attended with enlargement of the superficial veins, and the skin is white and pasty and pits deeply on pressure, thrombosis of the deep vein is plainly indicated. If a superficial vessel is affected, the hard cord with knot-like projections corresponding to the valves plainly indicates the affection. If the thrombosis is complicated with phlebitis there will be in addition the symptoms of this affection.

The treatment consists in complete and entire rest. The patient should be confined strictly to bed, and enjoined on no account to attempt to move from it. The limb should be fixed lightly on a splint so as to secure complete immobilisation, and raised above the level of the body so as to facilitate the return of venous blood. The internal administration of alkalies in sufficient quantities to render the urine neutral or slightly alkaline appears to have the best results in promoting the absorption of the clot, especially in rheumatic and gouty cases.

The treatment must, however, vary to a great extent according to the cause of the disease. If the thrombus is of an infective character, treatment is of little avail, but must be conducted on the broad principles laid down for the treatment of pyæmia, with which the disease is intimately associated. If it is complicated or accompanied by inflammation of the vein, the treatment presently to be described in speaking of that affection is to be adopted.

Inflammation of veins may be either plastic and local or suppurative and diffuse. The former arises from injury or extension of plastic inflammation from the tissues in the neighbourhood of the vein spreading to the vessel itself; the latter from infective thrombi. In the plastic form of phlebitis the external and middle coats of the vein become swollen and infiltrated with round cells; the internal coat becomes pulpy, degenerate, and blood-stained, and owing to these changes causes the blood in it to coagulate and a clot to form. The condition is strictly localised to the injured spot, and shows no tendency to spread. The clot formed in the vein may undergo the same changes as in thrombosis,—that is to say, it may organise, and thus with the vessel form an impervious cord, or it may be absorbed, the clot being first channelled in its centre and eventually entirely removed. Phlebitis.

The symptoms which characterise this condition are those of thrombosis, due to obstruction to the return of the blood through the plugged vein, with, if the vein is a superficial one, a hard knotted cord, with pain and tenderness along its course, and redness, and pitting on pressure of the skin over it. The treatment is the same in the main as that recommended for thrombosis, consisting of rest and position. In addition to this, much relief will generally be afforded by the application of warmth and moisture, as warm Goulard-lotion, to which opium may be added to relieve pain. Or equal parts of extract of belladonna and glycerine may be thickly smeared over the part, and then a fomentation. The suppurative form of phlebitis arises in those cases where a vein is wounded and becomes infected with septic material from the putrefying discharges in the tissues in the neighbourhood. The chief characteristic of this form of phlebitis is its spreading nature. A thrombus first forms in the vein at the part injured; this becomes infected from the neighbouring putrefying discharges, and then undergoes ‘puriform softening,’ and excites inflammation in the coats of the veins, which spreads far beyond the part originally injured. Fresh thrombi form above the original one, which break down and become puriform, and the process is

repeated. In their disintegration portions of the clot are often dislodged, and are carried in the circulation to distant parts, and, being infected with septic matter, form secondary clots in other vessels; and thus a general condition of pyæmia is set up. The symptoms of this serious affection are often not evident, and, indeed, are often not suspected till grave symptoms of septicæmia and pyæmia declare themselves. There may be pain and tenderness along the vein, and, if it is superficial, a firm knotted cord, surrounded by redness and œdema, together with œdema of the parts below. The redness and œdema will be found to extend rapidly along the course of the vein. Accompanying these local signs there will be the general symptoms of blood-poisoning. Should the patient live long enough, increased swelling occurs at one or more points in the course of the inflamed vein, which soon fluctuates and presents all the characters of an abscess, and when opened discharges a prune-juice-coloured, puriform matter. The treatment of this affection is usually of a most unsatisfactory nature. The disease is, as a rule, not recognised until the grave general condition is set up, and then it is too late to be of any avail. This, therefore, is a strong argument in favour of the only successful treatment—the preventive—that is to say, by efficient application of aseptic surgery to all wounds to prevent a disease which is almost certainly preventable by these means. If the disease is recognised early and the vein is a superficial one, it is certainly right to endeavour to hinder the progress of the inflammation, and defend the patient from the danger of the passage of the decomposing clot into the mass of the blood, by putting two needles beneath the vein and dividing it in the interval—a proceeding which I have seen, in the hands of Mr. H. Lee, to be followed by the happiest results. But, unfortunately, in these cases it is the deeper veins which are generally affected; and then the only resource, if the disease is recognised before the general contamination of the blood has taken place, is to amputate well above the inflamed vein, with all possible antiseptic precautions.

Varicose veins.

Varicosity or dilatation of veins is an exceedingly familiar affection as seen in the veins of the lower limb. It very commonly affects the veins of the spermatic cord, forming the disease known as varicocele. Many piles consist wholly or in part of varicose hæmorrhoidal veins, and other superficial and deep veins are occasionally found to be varicose. Dilated, tortuous, and varicose veins are also not unfrequently found ramifying under the skin and forming a collateral circulation in cases where any large trunk vein is obliterated. Thus, when the vena cava inferior has been plugged, large veins are developed under the skin of the abdomen, which bring the blood from some of the radicles of the obstructed vein into those of the superior vena cava, while the azygos circulation is, no doubt, also enlarged to convey the remainder.

The diseases caused by varicosity of special veins, and admitting of surgical treatment, will be found described in other chapters as VARICOCELE and HÆMORRHOIDS. We will deal here with varix of the lower extremity.

This may arise from any cause which throws too great or too continuous a strain on the veins, or which obstructs the return of blood from them. Thus, long-continued standing, especially in a heated atmosphere (as is done by soldiers, cooks, washerwomen), the pressure of garters, ill-fitting trusses, tumours, collections of fæces in the sigmoid flexure, the gravid uterus, want of support to the veins from relaxation of the tissues which should support them, are recognised causes of varix: and much may therefore be done in an early stage of the disease to mitigate or even to cure it by a removal of its cause.

The first effect of long-continued pressure on a vein is, of course, its dilatation. This dilatation, when not carried too far or continued too long, is susceptible of complete recovery by the natural elasticity of the tissues which form and those which support the vein. But if it be carried too far, the vein becomes permanently dilated, the valves cease to be adequate to close its tube, and the pressure is therefore transmitted to a lower part of the trunk, which thereby becomes similarly affected, and so a long track of the vein becomes permanently varicose. But there are other cases in which the dilatation affects only a small extent of the whole vein, and even some very rare ones in which only a portion of the calibre is dilated into a circumscribed tumour exactly resembling an aneurism.¹ Further changes follow on this dilatation of the vein. In the first instance, the coats of the veins are probably rendered thinner by their distension, and there are cases in which they remain thinner, and some in which they give way altogether; and the skin over them being also absorbed by the pressure of the varix, or ulcerated, external hæmorrhage results.



FIG. 279.—Limited varix (or venous aneurism) of the saphena vein. From a preparation in the Museum of St. George's Hospital, Ser. vi. No. 98, d. The affected portion of the vein was excised, along with the varix, and the patient did well.

In other cases the dilatation produced by the pressure causes thickening of the varicose vein. The skin is often greatly affected in this disease. The obstacle to the return of the blood causes congestion, followed often by low inflammation and ulceration. Hence varicose veins are the most prolific of all the causes of ulcer of the leg.

The superficial veins are chiefly affected, but it has been satisfactorily proved that the deep veins are not exempt, though the firm support which they receive from the muscles and fasciæ amongst which they lie prevents their attaining the size which the superficial veins do. This enlargement of the deep veins is testified by a general increase in the size of the limb, independent of the swelling of the superficial vessels, and by the sense of weight and aching on

hanging it down. And the occurrence of varicosity in the deep veins (though doubted by Mr. Callender) has been directly affirmed by Verneuil, who has put up some preparations in the Musée Dupuytren to show it.²

The treatment of varicose veins must be either palliative or radical. It has been pointed out above that in an early stage of the disease complete recovery may follow on the removal of the cause, the strengthening of the general health, so as to improve the tone of the tissues, and the unloading of the affected vein by rest in the raised posture. And even when the veins have

Treatment.

¹ There are two preparations of this condition in the Museum of St. George's Hospital.

² A recent writer (Giacomini—see 'Lond. Med. Record,' March 4, 1874) even goes so far as to say that varicosity of the superficial veins is always secondary to a varicose state of those deeper veins (inter- and intra-muscular) which establish a communication between the trunk veins accompanying the arteries and the subcutaneous vessels—the radicles of the saphenous. But the most complete and most suggestive account of the anatomy of the venous system is to be found in a series of papers by Mr. Gay, in the 'Lancet,' 1877, vols. i. and ii., which I earnestly recommend to the reader's attention.

been for some time varicose, if the disease has not progressed very far, rest in the raised position for a considerable time—say a month—and the application of firm but soft bandages, will often produce the complete disappearance of the enlargement, and relief of the symptoms. Still it is prudent to enforce the wearing of a well-fitting bandage or elastic stocking for a long while, and particularly during any strong exercise. When the enlargement has lasted long, and the veins have become much thickened, complete recovery cannot be expected, but much improvement may be procured by proper and well-fitting bandages and stockings.

The cases in which operative interference is desirable are not numerous, for it has been abundantly shown that if one varicose cluster is cured another will often, if not always, form,¹ and also that very much improvement may be obtained by rest and appropriate treatment even in the worst cases, so much as usually to allow complete relief to the symptoms, by proper apparatus. Now, as the same apparatus will be required even after the most successful operation, it may fairly be argued that the pain and risk of the latter have been superfluous. I admit this to some extent. Still, the operation is very much less formidable than that for varicocele, and it certainly gives speedy and effectual, though possibly only temporary, relief in many cases where there has been great pain, or where the patient has been much troubled with ulceration or inflammation of the skin. There are very numerous operations in use for varicose veins, but I will only describe that which my colleague Mr. H. Lee has introduced at St. George's Hospital, which is very easy, very efficient, and after which I have not as yet seen any serious accident. The vein is divided subcutaneously, while it is compressed above and below the point of division long enough to ensure its obliteration, but not long enough to allow any ulceration of the vein. Hence there is no way left by which any of the products of putrefaction or decomposition (should any such products form in the subcutaneous puncture) can pass into the cavity of the vein.

Subcutaneous division of varicose veins.

Two pins are to be passed under the vein, at a distance of about an inch from each other; and in doing so great care must be taken to lift the vein well up, and pass the pin below the vein and not through it. Compression is then made by twisting a figure-of-8 ligature round the pins, or by a piece of indiarubber, through which the pin is thrust before it is introduced, and which is then drawn over its point. Then a thin knife, a little longer and stronger in the blade than a tendon-knife, is passed under the vein, and the latter completely divided without cutting the skin.² Two or three circular pieces of plaister, encircling the whole leg, are then firmly applied over the puncture and the divided ends of the vein, and the patient is kept in bed, with the limb raised, for a week or ten days. The pins are removed at a time varying from two to five days. The former time is quite enough when all goes well and there is no excess of action round the subcutaneous wound; but if this should take place the surgeon may think it safer to keep up compression longer. The plaister need not be moved, unless suppuration is found to be going on. After the above time a bandage may be carefully applied, and the patient allowed to move about a little in the house. Then a well-fitting elastic

¹ Sir B. Brodie says: 'I always observed that if I cured one cluster two smaller ones appeared, one on each side, and that ultimately I left the patient no better than I found him.'—Works, vol. iii. p. 254. This, however, is certainly not always the case. I have seen patients quite well several years after the operation.

² Sir B. Brodie introduced the practice of dividing the veins subcutaneously. Mr. Lee added the temporary compression above and below, which so greatly tends to the patient's safety.

stocking should be worn. If there is an ulcer the patient should be kept in bed till it heals.

Recently many cases of varices requiring operative interference have been treated by complete excision, or by excision of a considerable length of the varicose vein, and, in the words of Mr. Davies Colley, this operation 'bids fair to supersede all other plans of operative treatment.' The operation of complete excision, originally recommended by Celsus, has been reintroduced into practice by Mr. Marshall,¹ and is very generally adopted by surgeons. When the coats of the vein are thickened and hypertrophied, the operation is a comparatively easy one, and with strict antiseptic precautions is not attended with much risk; whilst at the same time the permanency of the cure is much more assured than by the other operations formerly in vogue.

There are a few other affections of veins, which, however, are more pathological products than surgical diseases. The veins are peculiarly liable to hypertrophy and atrophy, according as the variations of the circulation throw the blood into anastomosing channels or the removal of parts deprives the veins of their chief function.

Other
affections
of veins.

Calcareous degeneration of veins is also spoken of, but it seems doubtful whether it is not usually a peculiar arrangement of phlebolithes. No disease is known in veins corresponding to the atheroma of arteries.

Malignant tumours frequently grow into veins; and every museum contains specimens of cancer protruding into the cavity of some large vein.

DISEASES OF THE ABSORBENTS.

THE absorbent vessels are, though very rarely, the seat of fistulous openings, through which their secretion is poured out on the surface of the body. This occurs more often in the groin, scrotum, and labium than in any other part, and is sometimes the result of a wound; at other times it proceeds from a varicose condition of the vessels, the cause of which is obscure, but which is often associated with elephantiasis of the lower part of the limb.² Dr. Vandyke Carter has noticed that in a case of 'chylous urine' a quantity of lymph was poured out of a minute opening in the thigh, and he believes that in some at least of these cases there is a preternatural communication between the receptaculum chyli or some of its large branches and the urinary passages, complicated with obstruction of the main lacteals and a varicose state of the lower lymphatics.³

Lymphatic
fistula.

Beyond attention to position, careful pressure by strapping or bandages, and avoidance of accumulation in the bowels, I do not see what can be done in such cases.

The commonest surgical affection connected with the lymphatic system is the inflammation which so commonly attends wounds, and which affects either the absorbent vessels themselves (inflamed absorbents—lymphangitis; angiopleuritis), or the glands (inflamed glands—lymphadenitis), or both.

Inflamma-
tion of the
absorbents
and of the
glands.

Inflammation of the absorbents is usually excited by a wound, but this is not invariably the case: the poison may be absorbed through mucous mem-

¹ 'Lancet,' vol. i. 1875, p. 113.

² Some other hypertrophic diseases besides the common elephantiasis are now believed to depend on a similar enlargement of the lymph-channels, e.g. macroglossia.

³ 'Med.-Chir. Trans.' vol. xlv.

branes, and even skin in which there is no scratch or abrasion to be found. If severe, the disease commences with considerable fever and rigors; soon red lines are seen running up the course of the lymphatics, and terminating at the nearest gland. This is often accompanied by sharp pain, and always by great tenderness. The redness and tenderness are easily distinguished from those which are found in phlebitis, inasmuch as the lines, though much thicker than the absorbent vessels, are far less extensive than would be caused by inflammation of the cellular tissue around the veins, and the red streaks run in the course of the absorbents, not in that of the veins. The redness in all cases ceases at the gland or glands to which the absorbents run; and those glands are tender, red, and hot, and they are very liable to suppuration, which involves mainly the cellular tissue around the gland, and which on its subsidence does not seem to leave the gland permanently impaired in function, though, no doubt, suppuration takes place in the tissue of the gland, as well as in that which surrounds it. In rare cases there are abscesses in the course of the lymphatic before it reaches the gland.

Inflammation of a gland, however (adenitis), occurs constantly without any previous inflammation of the lymphatics which supply it, as we see every day in the cervical glands, in the bubo of gonorrhœa and syphilis, and in a thousand other cases.

The inflammation, or bubo, seems in all cases conservative—the products of inflammation are resolved in the gland, and instead of passing into the mass of the blood to excite fermentation and septicæmia, they are expended in the production of an abscess which, in all ordinary cases, is a mere local trouble. There are, of course, exceptions to this, and they have been already alluded to in the chapter on Poisoned Wounds (p. 79); but it remains true that inflammation of the absorbent glands is a safeguard against the passage of poisonous material into the blood, and one which, considering the constant occurrence of the danger, is very efficient.

The treatment of inflamed absorbents is generally very simple. The primary cause of the inflammation should be sought for, and the wound, if any, at once cleansed with carbolic or corrosive sublimate lotion, any pent-up pus evacuated, and the part dusted over with iodoform. The inflamed vessels must be treated with rest, and the application of warmth is generally grateful to the patient. Perhaps the most universally employed remedy, and to my mind the best, is belladonna. Equal parts of glycerine and extract of belladonna are thickly smeared along the inflamed vessels, and then a fomentation is applied. Some surgeons prefer warm Goulard-lotion with opium. The bowels should be freely purged; and the general treatment should be the same as for erysipelas, to which this disease bears such a close relationship.

Inflammation of the absorbent glands requires the same general treatment. Locally, warm poultices are the best application. It is an error, I think, to believe that poultices promote suppuration; on the contrary, they seem to prevent it when it is preventible, though when it has commenced they soften and relax the tissues, and facilitate the progress of the matter towards the skin. As soon as matter is detected the abscess should be freely opened.

If the inflammation remains long in a chronic state nothing is so useful as a blister. In some cases it causes the recession of the inflammation and subsidence of the glandular enlargement; more commonly it brings the abscess to a head.

The glands sympathise, or, more properly speaking, are involved, in a great number of different kinds of inflammatory and constitutional diseases—in struma, syphilis, and cancer especially. Strumous glands are most common in the neck, and often appear to be affected without any evidence of any primary lesion in those parts from which they derive their lymph. But there is very little doubt that though in any given case we may be unable to discover any peripheral lesion which initiated the gland affection, nevertheless some such lesion really existed. In a certain percentage of cases there is abundant evidence in the shape of some cutaneous eruption on the scalp or face, caries of the teeth, &c., of the cause of the glandular enlargement; but in the majority of cases this is not so, and then the source of irritation is to be sought in the mucous membrane of the mouth or throat, and, failing this, in the mucous membrane lining the nasal, aural, or ocular surfaces; and though in some cases after the most diligent search no peripheral lesion can be found, nevertheless it is almost certain that some such lesion has existed and has been the initial cause of the gland enlargement, and that the irritation has been propagated from the mucous or skin surface to the lymphatic glands of the neck. The disease in the first instance consists of an enlargement and cellular infiltration of the gland structure, the cellular infiltration generally appearing in patches towards the centre of the gland. Then large ‘epithelioid’ cells make their appearance, and sometimes typical tubercle with giant cells occupied by the tubercle bacillus. If the disease progresses, caseation takes place in these tubercular masses, and the whole gland becomes fused into a cheesy mass, and softening and suppuration quickly follow. The glands which were at first isolated and freely movable become fixed and agglutinated together and to surrounding parts; they then soften, and evidence of suppuration is apparent.

In the early stage, before actual caseation takes place, the condition is recoverable from, and the glands may return to their natural state. The treatment consists in removing if possible the peripheral irritation which was the cause of the gland enlargement. The general and constitutional treatment of scrofula (page 386) must be rigidly carried out, and benefit may be obtained by local means, such as counter-irritants. At all events, no harm can be done by their judicious employment. But if there is evidence that the glands are caseating and softening, as shown by their becoming fused together and to surrounding parts, there is a clear indication for the necessity of thoroughly eradicating them. Not only because, if this is not done, an abscess will form which will show little tendency to repair, but form a suppurating tract with undermined edges, which may go on discharging for months or years, deteriorating the patient’s health; but also, and chiefly, because the suppurating gland may form the focus from which the inoculation of the system with elements favouring the development of general tuberculosis may take place. This plan of treatment has been strongly advocated by Dr. Clifford Allbutt, in a paper read before the International Congress in 1881,¹ in which he comes to the following (amongst other) conclusions: (1) ‘That especially by surgical dissection, the disease may be promptly removed and the patient cured in a few weeks; (2) that by this method disfigurement, if not wholly averted, is reduced to the least amount; and (3) that the subsequent health is, after such procedure, re-established in a way that is not possible under any other mode of cure, and that the risk of future phthisis or other malady caused by septic absorption is averted.’ As a rule the treatment

¹ ‘Trans.’ vol. ii. p. 82.

is best accomplished by scraping—a method which is applicable to all glands when they have caseated or begun to soften. The gland is freely incised, and every particle of morbid tissue carefully scraped away with a Volkmann's spoon or other suitable instrument. Mr. Teale,¹ who operated in most of Dr. Allbutt's cases, points out that frequently there is a degenerate gland beneath the deep fascia, which communicates with the superficial parts by a small opening only large enough to admit a director. This should be borne in mind in any scraping operation, and if such a small opening in the deep fascia is found it should be freely incised and the underlying gland thoroughly scraped out. Occasionally, instead of scraping, formal excision is resorted to in cases where there are only one or two greatly enlarged glands which show no tendency to fuse together or to adjacent parts.

Mr. Treves² speaks favourably of the results of operations on strumous glands with the thermo-cautery, which he thus describes: 'I use a fine point of the thermo-cautery about the size of a No. 7 catheter. This, being heated to a bright red heat, is thrust through the skin into the substance of the gland, and is passed in several directions through the gland-tissue before it is withdrawn. If there are any purulent collections in the tumour, they have free exit. The hole formed by the cautery remains patent for some time, and allows any broken-down tissue to be discharged. As a rule, very little reaction follows. In many cases scarcely any discharge follows the application of the cautery point, but the gland in a few days begins to shrink, and very commonly ceases to give any more trouble. In only one instance out of some twenty did the skin become undermined. This procedure is applicable to almost any glands that have attained the size of a walnut, and answers admirably in the case of large adherent lobulated masses. It is not applicable to gland tumours that are still freely movable.'

The treatment of syphilitic glands resolves itself into that of the constitutional affection on which it depends. Cancerous glands usually admit of no treatment, unless the surgeon thinks fit to regard them as part of the primary tumour and extirpate them along with it.

¹ 'System of Surgery,' 3rd ed. vol. i. p. 233.

² 'Med. Times and Gaz.' vol. i. 1885, p. 37.

CHAPTER XXX.

SURGICAL DISEASES OF THE HEAD AND FACE.

CONGENITAL MALFORMATIONS.

HARELIP is one of the commonest of all the congenital deformities. It is named from the general resemblance which no doubt it bears to the cleft lip of the hare; though, as Sir W. Fergusson remarks, the resemblance fails in this important particular, that the cleft in the hare's lip is in the middle line, which it hardly ever is in the malformation.¹ It is often hereditary, and in children who suffer from it, or in members of the same family, other deformities are often found. (See a remarkable instance in Cooper Forster's 'Surgical Diseases of Children,' p. 30.) Harelip may be divided into simple, double, and complicated.



FIG. 280. Diagram of the common single harelip.—Holmes's 'Surg. Dis. of Childhood.'

In simple harelip there is a cleft through the upper lip,² on one side of the middle line, but no other deformity. The cleft, for some unknown reason, is usually on the left side, and it generally extends from the nostril to the free edge of the lip. The nostril also is expanded on the affected side. These features are shown on the appended diagram, which shows also

what is very common in harelip, viz. that the vertical extent of one side of the cleft is less than that of the other.

In some cases this inequality is still more marked; and in others, again, the two halves of the lip lie on different levels (Figs. 281, 282).

The cure of the simplest cases of this deformity is very easy. Nothing is required except to pare off an amount of tissue from either side of the cleft sufficient to refresh the whole thickness of the lip on both sides, and then to bring the two sides together with the harelip suture. Before paring the edges it is well to turn out the two parts of the lip, and divide any adhesion to the jaw which might possibly displace either half. A few points in this little operation call for more detailed notice. 1. As to the age at which to operate. In simple cases there is no reason at all why the operation should not be done at the earliest age at which the infant is seen. It has even been done on the first day of life; but this is hardly desirable; and as there is no hurry (for the defect occasions no impediment to suckling), it is, on the whole, better to wait till the child is two or three months old, and is seen to be healthy and vigorous. Weakly infants should not be operated on, as a general rule. 2. As to administering chloroform or ether. This seems to me unnecessary, since the operation is so soon over; but there is no objec-

¹ In one instance of extensive deformity figured by Mr. Pollock ('Syst. of Surg.' 3rd ed. vol. ii. p. 501) the cleft was in the middle line, and Rokitansky refers to another case; but both these were instances of complete cleft of the palate, and the incisive bone was absent. I have, however, heard of a case in which simple harelip was median.

² As surgical curiosities clefts of the lower lip or clefts of the cheek have been recorded.—See Holmes's 'Surgical Diseases of Childhood,' 2nd ed. p. 127.

tion to it if the surgeon or the parents prefer it. 3. As to the attitude in which the child is to be placed. I prefer the child in the recumbent position on the operating-table; with an assistant behind the child, who steadies the head with the palm of the hand on either side, whilst at the same time he compresses the two sides of the lip between his finger and thumb. A pair of double forceps has been introduced by Mr. T. Smith for holding both sides of the lip with a sort of clamp, and this may be useful in the absence of a trained assistant; but, as a general rule, it is superfluous. 4. As to the instruments. I much prefer the knife; some surgeons, I believe, still use scissors, which are inferior, inasmuch as they only allow of a single straight incision, whilst, as I shall presently show, it is often necessary to modify the direction of the incision in various ways. 5. As to the suture. 'The hare-lip suture' will be found figured in the chapter on 'Minor Surgery,' and it is a very efficient and secure method of holding the parts together till union is complete. But it has the drawback that the needles may make a small scar at each of their points of puncture. This usually depends on their having been kept in too long. If withdrawn, as they should be, in forty-eight hours,

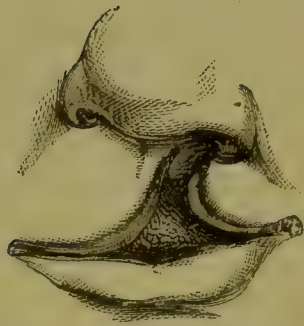


FIG. 281. A drawing from life of a harelip with unequal sides.—Holmes's 'Surg. Dis. of Childhood.'



FIG. 282. Harelip showing the two parts on different levels as well as unequal.—Holmes's 'Surg. Dis. of Childhood.'

they usually leave no mark; and it seems useless to keep them in longer than this, since they are more likely to do harm by setting up suppuration than good by keeping the parts in apposition. However, if the lip is small, there is no real need for the needles. The interrupted or continuous suture answers perfectly, and is best made of silver wire. Some surgeons prefer to clamp the wire with shot, or with a button of some kind.¹ But whatever be the material or form of the suture, it is essential that it should bring the whole of the lip in apposition, i.e. that the suture should be placed close upon the mucous membrane—and that for two reasons. First, that as the coronary arteries lie between the muscles and mucous membrane a too superficial suture might leave them uncommanded, and they would bleed into the mouth; and, secondly, that if the whole lip were not brought together the resulting cicatrix might be too weak to bear the traction of the muscles and might give way. Generally a fine suture at the edge of the lip is necessary in order to maintain the perfect evenness of the red line there.

¹ An ingenious clamp was lately introduced by my colleague Mr. Pollock under the name of the 'gun-nipple button.'

The child should be put to the breast as soon as the operation is over, and very soon forgets it.

After two days the whole of the suture should be well oiled and withdrawn, the two parts of the lip being held firmly together with the fingers, while two or three long straps of plaister are applied, taking hold of the cheeks by means of broad ends, while their narrower central parts cover the wound.

In cases where the inequality between the two parts is great the simple operation will not give a satisfactory result. It is then better to leave the



FIG. 283. Operation for harelip with unequal sides, by leaving one of the pared edges (that on the left side) attached, and implanting it into the opposite flap, the edge of which has been sloped to receive it.—Holmes's 'Surg. Dis. of Childhood.'

flap on the narrower side attached by its base, and to slope off the incision on the broader side, as shown in Fig. 283. The flap left attached on the narrower side is implanted into the broader flap, and fills up the gap which would otherwise be left. Of course, if the pendulous flap seems too large for the gap, it may be trimmed away as much as necessary. In other cases, where both sides of the cleft are much inferior in depth to the rest of the lip, both flaps or portions of them may be left attached at their lower part, turned down, and sewn together, so as to form a prominent tubercle. This



FIG. 284. Diagram of Clémot's operation for incomplete harelip. *a* shows the furrow which unites the two halves at the lip; *b* the incision on one side, which runs down towards but not to the red edge of the lip. The second figure shows these flaps drawn down and the suture which unites the wound, which is now of a diamond shape.—Holmes's 'Surg. Dis. of Childhood.'

tubercle, though it may appear redundant at first, will gradually become modelled down.

Closely allied to this operation (which bears the name of Nélaton) is a proceeding introduced by M. Clémot for the cure of cases of incomplete harelip, i.e. clefts which do not extend into the nostril. It consists (Fig. 284) in making an incision like a **V** reversed around the cleft, leaving both flaps attached at their base, and drawing them down, so as to form a diamond-shaped wound, which is then sewn together, and thus a considerable protuberance is substituted for the cleft. Incomplete cleft.

Double
harelip.

Uncomplicated double harelip is not a very much more serious malformation than single harelip; at least, it is almost as easy to cure by operation, though the deformity left will probably be greater. In this form of malformation there is a median tubercle, bounded on either side by clefts, of which very commonly one reaches into the nostril, while the other does not, or both may be complete. The nose is depressed and the nostrils widened. The incisive bone, which corresponds to the median tubercle, carries generally four teeth, but their number varies. In uncomplicated harelip there is no actual fissure in the bony palate, nor any malposition of the os incisivum, though some trace of a cleft on one or both sides is not infrequently noticed on close examination.



FIG. 285. Diagram of double harelip.—Holmes's 'Surg. Dis. of Childhood.'

The operation for uncomplicated double harelip consists in paring both sides of the median tubercle by two incisions meeting in a point below, so as to leave in the centre a triangular piece, with its base upwards. The edges of the two lateral portions of the lip are then pared, and these pieces attached above to the central piece, and below this (for the central piece is always narrower than the rest of the lip) to each other. As there is often, if not always, considerable traction on this lower part, and a gap or fissure generally exists after this simple operation, it is often advisable to leave part or the whole of the lateral flaps attached and to implant them into each other, to fill up the gap.

Complicated
harelip.

Harelip, either single or double, may be complicated with fissure of the palate, and when this is the case in double harelip the incisive bone often projects considerably, and appears to hang on to the end of the nose (Fig. 287). In such cases, or in single harelip when the two portions of the jaw are on a different level (Fig. 282), the gap may be very wide, and there will be much difficulty in filling it up. Hence the importance of not removing any of the already existing tissue if it can possibly be saved and made available for that purpose. It would be out of place here to describe all the ingenious operations which have been invented for the cure of complicated harelip. I will limit myself to two or three of the more useful. In cases with very extensive cleft, or with a projection of one portion of the jaw, the 'operation of Giralaldès' will be found useful. Flaps are cut on either side, and are left attached on one (the right in the diagram) by the lower, on the other (the left in the diagram) by the upper end, the incisions being carried round the nose as far as may be deemed necessary (Fig. 288). The flap, attached by its lower end, is then turned downwards, so that its red edge forms the border of the lip, while the other is drawn upwards towards the nostril, and they are thus dovetailed together with interrupted sutures. If the surgeon thinks it safer he can support his sutures for a day or two by a harelip-pin in the centre.

When the median tubercle projects (Fig. 287) it is often removed with the cutting-pliers before the operation, the skin covering it being saved, either to fit into the gap or to sew on to the central incision and help to form the columella; and if the projection be very great and the portion of bone much isolated it may be well to follow this course. But if the incisive bone can be

¹ 'Leçons cliniques sur les Mal. Chir. des Enfants,' 1868, pp. 155-6.

preserved it will be found useful in preventing the extremely disagreeable underhung appearance which its removal gives to the profile.¹ There are several ways of dealing with this projection. The easiest, but also the rudest and least secure, method is to break it from the vomer and press it back into the cleft between the two halves of the upper jaw. A better plan is either to make an incision with a strong pair of scissors, through the septum, or, as recommended by Blandin, to cut out a triangular piece from the septum.

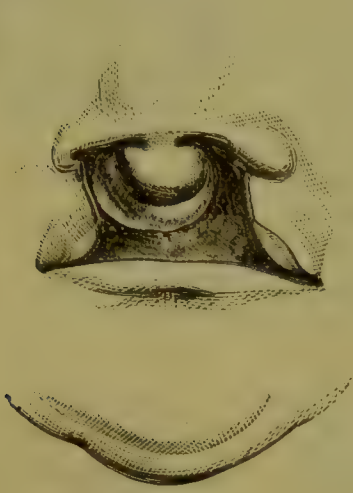


FIG. 286. Front view of double harelip with projection of intermaxillary bone.



FIG. 287. Side-view of the same case.—Holmes's 'Surg. Dis. of Childhood.'

This allows the surgeon to press back the intermaxillary portion between the two maxillæ. Bruns recommends that the two parts of the septum nasi be drawn together with sutures; but this recommendation is by no means easy to carry out in practice: and Langenbeck fixes the intermaxillary portion by sutures to the maxillæ. It is very true that the intermaxillary portion thus replaced often remains more or less loose, and it is also true that the teeth which it contains are often misplaced, but they can be drawn, and the incisive

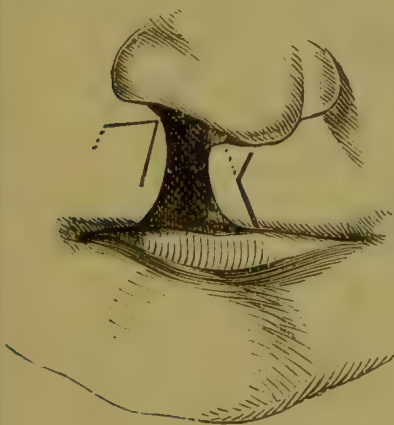


FIG. 288. Giraldès' operation for harelip.—Holmes's 'Surg. Dis. of Childhood.'



bone will form a useful support for a tooth-plate when the median tubercle has been thus depressed. The case is then to be dealt with as any other complicated case of harelip, and in doing so the surgeon must always remember the great benefit which may be obtained in relieving tension and favouring the adaptation of the flaps by carrying incisions round the nostrils.²

¹ See two figs. Nos. 21 and 25, in my book on 'Surgical Diseases of Childhood.'

² See Sédillot, 'Contributions à la Chirurgie,' vol. ii. p. 622.

In these operations for wide cleft the use of Hainsby's truss to support and press together the flaps is very advisable, as it prevents dragging on the sutures without opposing any impediment to suckling.

The operation for harelip, if practised with moderate dexterity, and on healthy children, almost always succeeds in simple cases, and usually even in those which are more complicated. It is not, however, devoid of danger, either from the exhaustion of hæmorrhage, or from diptheritic or other unhealthy inflammation of the wound. Failure of primary union sometimes occurs, and in such cases it may be advisable, when the granulations from the two cut surfaces look quite healthy, to bring them together again with sutures or strapping, and so attempt a cure by 'secondary adhesion' (see page 27).



FIG. 289. Hainsby's truss.

Fissured
palate.

Fissured palate is a malformation which often exists along with harelip, but also very often without it. When the fissure is confined to the soft palate, or extends only through a part of the bony palate, there will be no deformity of the lip; whilst if harelip is complicated with fissure of the hard palate the

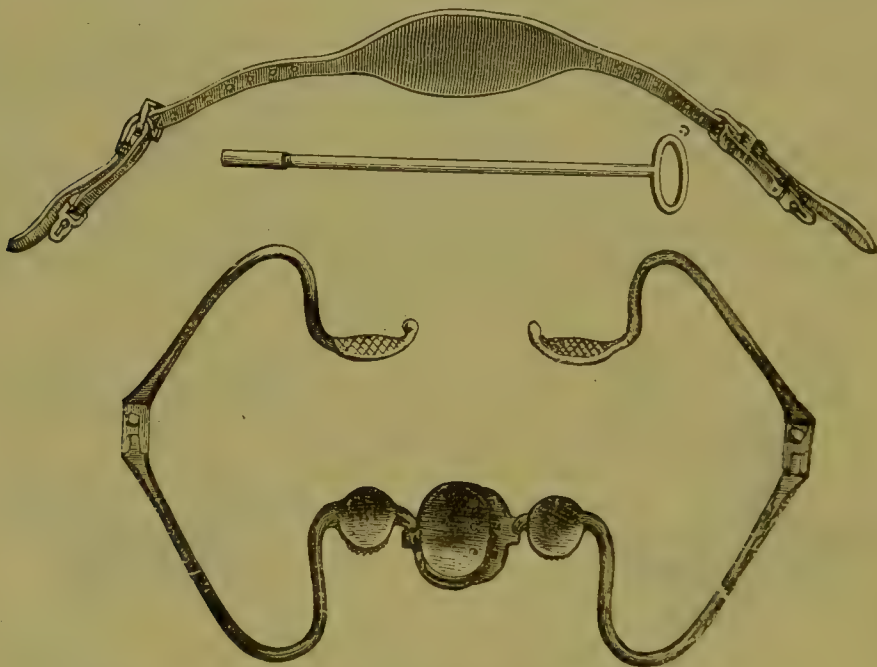


FIG. 290. Smith's gag for staphyloraphy.

cleft generally extends through the whole mouth, from the red edge of the lip in front to the uvula behind.

Three grades of this deformity may be described: (1) simple fissure of the soft palate; (2) fissure of the soft and part of the hard palate; (3) complete cleft.

The simple fissure of the soft palate is an affection which is now treated with almost uniform success. The operation which was introduced into general practice by Roux, and was perfected by Sir W. Fergusson, was applied exclusively to adults, or at least to persons above the age of puberty who

could endure the pain of the operation, and assist the surgeon during its performance. Since that time, Mr. T. Smith, by the invention of the gag which bears his name, and the use of anæsthetics, has rendered it possible to operate in early infancy, before the child has acquired that vicious habit of defective articulation which is so difficult afterwards to unlearn.¹ The only infirmity of any consequence which is connected with the minor grades of the malformation is the defect of articulation. Children easily acquire the power of deglutition, though perhaps at first some of the fluid will run out at the nose; and patients with fissured palates are usually as healthy and well nourished as any others. But the defect in speaking is a most serious impediment to the education and comfort of a young person, and it is of great importance to remedy it as early as possible. Cases have been operated on with success at the very earliest periods of life; but there is some little risk in so doing from the bleeding, and there is much greater probability of failure from non-union of the wound, in consequence of some of the numerous disturbances of health to which infants are liable, so that the age of three or four is generally selected. The operation consists in first paring the edges of the cleft, then

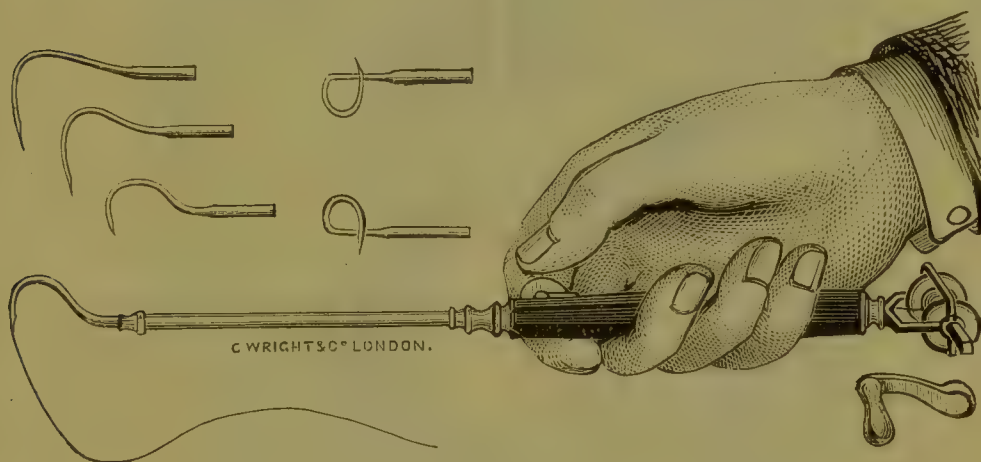


FIG. 291.—Smith's needle for passing the sutures in cleft palate.

passing sutures through the flaps, and bringing the edges together in their whole extent, and, finally, dividing the muscles sufficiently to obviate any traction on the sutures. The patient being fully anæsthetised, the gag here represented (Fig. 290) is to be introduced closed and then dilated to its full extent, it having, of course, been carefully fitted to the mouth on a previous day. Then the edge of one of the halves of the palate is to be seized with a long pair of clawed forceps, and the whole edge (including the part which has been grasped by the forceps) rapidly removed, and the same on the other side. If the surgeon be completely ambidextrous this is most rapidly done by changing the knife into the left hand; but most operators find it more convenient to cross the hands. Then the sutures are passed rapidly through each flap. This can be easily done by means of the very ingenious needle invented by Mr. Smith (Fig. 291), which allows of the suture being passed

Operation
for fissured
palate, or
staphylo-
raphy.

¹ Other operators had made use of chloroform, and had obtained some success, about the same time as Mr. Smith's earliest operations (see note on p. 118 of the second edition of my work on the 'Surgical Treatment of Children's Diseases'); but the merit of introducing the operation in infancy into general use certainly belongs to him. Mr. Smith's paper will be found in 'Med.-Chir. Trans.' vol. li.

through both sides of the cleft at once. The sutures are then twisted and cut off short, with the exception of the lowest one in the uvula, which is left long in order that the surgeon may put the palate on the stretch by drawing on that suture while he divides the muscles.

All this having been completed, the surgeon proceeds to divide the muscles by passing a fine knife (that used for paring the edges will answer perfectly) through the palate close inside the hamular process, and drawing its edge as far along the upper surface of the soft palate as may be necessary to paralyse the action of the levator palati (Fig. 292). A very slight acquaintance with the anatomy of the soft palate will suffice to prove the correctness of the opinion expressed by Sir W. Fergusson, that the division of this muscle is the most effectual and necessary method of obviating any traction on the edges of the wound after staphyloraphy. But, after its division, should there

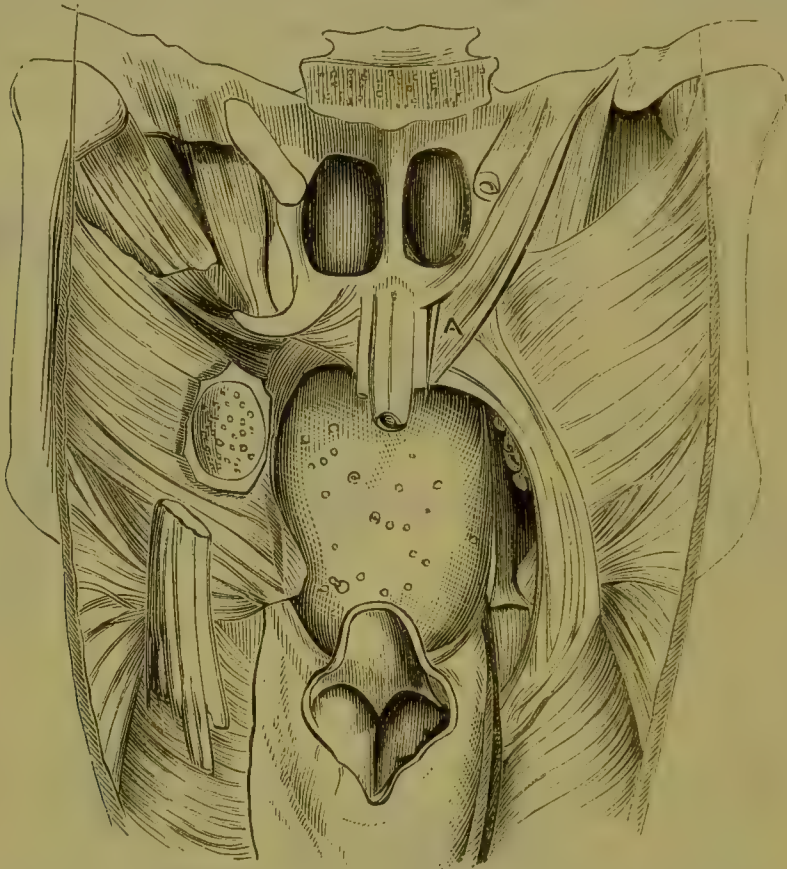


FIG. 292. Dissection of the muscles of the soft palate, showing the levator palati on the right side, with the knife (A) entered close to the hamular process (which is exposed on the other side by the removal of the levator palati). It will be seen that by applying the edge of the knife to the posterior or upper surface of the palate flap almost the whole of the muscle may be divided. The palato-pharyngeus or posterior pillar of the fauces is also shown on this side. The muscle can be easily cut across with a pair of scissors if necessary.

still be any tension or traction on the edges of the wound, a free lateral incision should be made through the soft tissues of the palate close to the alveolar margin until all tension is overcome. No harm appears to arise from these incisions, and it is certain that the success of the operation depends on securing a condition of complete relaxation and absence of traction on the sutures.

The best form of suture is undoubtedly the silver suture, which produces no irritation. Some surgeons prefer horsehair, but they are difficult to manipulate and liable to break. For the soft palate they may be used sometimes with advantage, but even here I prefer fine silver.

After the operation the patient should be well fed on fluid or soft semi-solid food, with wine if the child be depressed or weakly. It used to be thought necessary to prevent him from speaking for some days, but this is impossible with children, and indeed seems unessential.

When the fissure extends only a little way through the hard palate it may be treated like one of the soft palate only. If a small perforation is left it will probably fill up spontaneously or can be filled up afterwards. But if the whole or the greater part of the hard palate is cleft, the mucous membrane and periosteum must be dissected away from the bone, and the muco-periosteal flaps thus made brought down and united in the middle line. In doing this an incision is first made along the edge of the cleft at the line of junction of the nasal and palatal mucous membrane. A small incision is then made in the muco-periosteum close to the alveolar process, and a curved periosteum elevator, shaped like an aneurism needle, is introduced into the incision and the muco-periosteum gradually prized off the bone, as far as the first incision, until the soft parts are entirely detached and hang like a curtain. They will still, however, be found to be attached at the posterior border of the hard palate by the mucous membrane, which passes from the posterior surface of the soft palate to cover the floor of the nasal fossæ. This reflection of mucous membrane must now be divided by a pair of curved scissors introduced through the cleft, and the whole of the muco-periosteum of the hard palate, together with the soft palate, will lie loose and flaccid in the mouth. Langenbeck has laid much stress on the advantage of denuding the bones of periosteum in this operation, and is often spoken of as having introduced a new method of operating; but it appears certain to me that his operation differs in no material particular from that which Mr. Avery and Mr. Pollock practised long ago, though he may have more distinctly laid stress on the fact that the periosteum is (to some degree at any rate) contained in the flap. I say 'to some degree,' for the bone is too irregular in its surface to permit of the periosteum being removed entire. Mr. Pollock¹ has shown that the prospect of success in complete cleft of the palate is in one respect better than in partial cleft, since in complete cleft the edges of the fissure are nearly vertical, while in partial cleft they are more nearly horizontal. The consequence is that when the flaps are pared off the former they meet in the middle line without any tension, while in the latter they are hardly long enough to fill the gap.

It seems good policy, if there is not too much bleeding, to unite the whole cleft at once, as the complete liberation of the whole of the soft parts allows the flaps to come together without any tension, and the lateral incisions will possibly render any division of the muscles superfluous.

When harelip is also present it is well to operate upon it in early infancy, and this will press the halves together and limit the extent of the cleft; but it is better to defer the more serious operation till three or four years of age.

Shortly before his death Sir W. Fergusson introduced a modification of the operation of staphyloraphy, by osteoplasty. Instead of paring the membrane off the bone he divided the latter with bone-scissors in the line of the incision made near the alveolar process (for which purpose a hole is first to be made through the bone with a sharp chisel), and then the whole moiety of the cleft (bone and all) is displaced to meet its fellow of the opposite side, which is similarly treated. The edges are then pared and the flaps sewn together with stout sutures.

¹ 'System of Surgery,' 3rd ed. vol. ii. p. 511.

Macro-
stomia.

An arrest of development somewhat similar to harelip sometimes takes place between the upper and lower part of the first visceral arch, resulting in a unilateral fissure extending from the corner of the mouth into the cheek. This produces an unsightly deformity, more marked upon any attempt being made to laugh or smile, and in consequence of the non-union of the fibres of the orbicularis oris muscle there is an appearance of vacancy of expression in the face. The treatment consists in paring the edges of the fissure and bringing them accurately in apposition with silver suture. The operation is best deferred until the child is weaned and better able to withstand the loss of blood and shock of the operation.

Meningo-
cele and
encephalo-
cele.

The other malformations which occur about the head and face are too rare and too little amenable to treatment to render it worth while to discuss them here; but I must refer shortly to meningocele and encephalocele, on account of the interesting questions of diagnosis to which they give rise. They are congenital affections, having the same relation to the cranium and brain which spina bifida has to the spinal column and cord; that is to say, the ossification of the bony case being incomplete, the effusion of fluid—the result of some ill-understood action during foetal life—forces either the membranes or the nervous substance itself through the unossified part.¹ In the spinal column the nerve-centre is rarely affected. In the brain it is so comparatively often. The fluid collects in the ventricular cavity, and some part of the brain is forced out of the hole in the skull. This is an encephalocele. When the effusion is wholly outside the brain, so that the protrusion is formed only by a bag of the membranes, the tumour is called a meningocele. These protrusions are most common at the post-condylar part of the occipital bone, which in early foetal life is usually composed of four distinct centres of ossification;² and it is between these centres—i.e. just behind the foramen magnum—that the protrusion occurs. Another favourite situation is at the junction of the frontal and nasal bones, but any part of the cranium may be the seat of the protrusion, even the base of the skull, and here the effusion is probably in the third ventricle.

The fluid of a meningocele is sometimes completely free in a cyst formed by the dura mater and its arachnoid covering, exactly as in common hydrocele. Such tumours may be completely transparent, and hang over the nape of the neck from a pedicle which reaches up to the occiput. But at other times the fluid is contained in a multilocular tissue, much resembling an enormous over-development of the pia mater,³ or possibly formed by protrusions from the falces of the dura mater. Very often along with the watery fluid a small portion of the surface of the brain projects beyond the hole in the skull, forming what is called a hydrencephalocele. Pure encephaloceles—i.e. protrusions consisting of the brain-substance lying immediately beneath the hernial sac—are rare. They are of small size, and very often produce no symptoms and display little tendency to increase (Hewett, *op. cit.* p. 133).

¹ Such at least is the common opinion, though Sir Prescott Hewett has given strong reasons for doubting it. If the hole in the skull be not the result of arrested development, it must be attributed to pressure by the dropsical brain; but then it is difficult to say why it affects one situation rather than another. Now, the protrusion is as common in the occipital region as in all the other situations put together. See Prescott Hewett, in 'St. George's Hosp. Reports,' vol. vi.

² See Gray's 'Anatomy,' 10th ed. p. 23, footnote.

³ See Holmes, 'On a Case of Meningocele,' in 'St. George's Hosp. Reports,' vol. i. p. 40.

Little or nothing can be done for such tumours. Their removal, even when they consist obviously of nothing but water, is too dangerous to be justifiable. Pressure after evacuation of part of the fluid may be tried, and in some cases seems to have done good. Iodine injection has been used (by myself and others), but no success can be claimed. The chief importance of the subject, indeed, is to know the diagnosis of such a tumour, in order to avoid any surgical interference. Such tumours have been mistaken for *nævus* (degenerated or otherwise), and for sebaceous and other tumours, and many fatal operations have thus been occasioned; while in other cases the patient has been lucky enough to escape with life, even after the removal of a portion of the brain.¹

The two great points in the diagnosis of these tumours of the brain are the history—showing that the growth is congenital—and the situation in which it forms. But as *nævus* is always congenital, and sebaceous tumours also sometimes, it is necessary to study very carefully the effects of pressure on the tumour, and to examine the lump most minutely, in order to ascertain the presence or absence of a hole in the skull. In a congenital tumour believed to be a degenerated *nævus*, or other growth unconnected with the brain, no operation should be ventured upon until the surgeon is completely satisfied that the lump is in no degree reducible, that pressure on it produces no head symptoms, and that its base is free from the bones of the skull.

TUMOURS OF THE CRANIUM.

TUMOURS sometimes arise in after-life which perforate the cranium and lie in direct communication with the membranes of the brain, as in the remarkable instance here figured. These cases were first introduced to the notice of surgeons in Louis' celebrated Memoir on 'Fungous Tumours of the Dura Mater,'² where, however, it is clear that several different forms of tumour are confounded together. Some of the swellings there described were very probably (like Mr. Cæsar Hawkins's case) fibrous or fibroid tumours springing from the cranium and growing outwards and inwards. Such tumours are distinguished by their slow growth, the imperfect pulsation they receive from the subjacent brain, and the cerebral symptoms which they occasion, and which vary with the state of congestion of the tumour. Others were malignant. These also probably originate in the bone, but they grow much more rapidly, pulsate much more violently, and destroy life rapidly. I have seen a tumour of this sort mistaken for aneurism by anastomosis, from which, however, the symptoms of pressure on the brain should have distinguished it. Then there are swellings caused by a hernia of the brain in consequence of disease in the bones of the skull, as in the case related by Mr. Cæsar Hawkins, *op. cit.* p. 351; and several of Louis' cases seem to have been of this nature. Whether tumours occur which can in strictness be called 'of the dura mater'—i.e. new growths springing from that membrane itself—seems doubtful. The cases altogether are very rare, but are important in respect of diagnosis.

In connection with the subject of tumours of the cranium, it is necessary to make some allusion to the subject of the removal of tumours of the brain, which operation has been recently performed in some few instances. The

Removal of
cerebral
tumours.

¹ See Sir P. Hewett's account of an operation by Mr. Tatum. *Op. cit.* p. 144.

² In the 'Memoirs of the Academy of Surgery,' trans. for the Sydenham Society by Drewry Ottley.

first case which has been published occurred in the practice of Dr. Hughes Bennett; ¹ Mr. Godlee being the operator. The locality of the tumour was correctly diagnosed and the operation was successful as far as the removal of the tumour was concerned, but the patient died from hernia cerebri and meningitis. The patient was a man aged 25. His chief symptoms were paralysis of the left upper extremity, intense headache, optic neuritis and vomiting. The diagnosis of a tumour at the middle third of the fissure of Rolando was made and the skull trephined in this situation. A glioma the



A. Internal view.

B. External view.

FIG. 293. 'Fibrous tumour of the dura mater,' taken from a patient who was under Mr. Caesar Hawkins's care in St. George's Hospital at intervals, during a great number of years, and who died from an accidental attack of pneumonia, about sixteen years after he had noticed the tumour. The latter had been stationary for many years before death. Its pressure on the brain caused slight epileptic fits and much loss of memory and mental power, but did not affect the general health. Pulsation existed in one or two of the softer parts of the tumour (communicated probably from the brain), and pressure there made him feel faint and oppressed. On post-mortem examination the tumour was found covered by the thickened pericranium, as shown at B. It perforated the skull, and also the dura mater, so that it rested on the surface of the brain. It consisted of a mixture of fibrous tissue with delicate bony spiculae, covered in almost the whole of its extent by a thin layer of bone. The soft part of the tumour was composed entirely of a mass of spindle-shaped fibres. The brain, though considerably compressed by the tumour, was not otherwise affected.—St. George's Hospital Museum, Ser. xvii. No. 39. Caesar Hawkins's 'Contributions to Pathology and Surgery,' vol. i. p. 356.

size of a walnut was found, and removed with a Volkmann's spoon. Bleeding was arrested with the actual cautery.

Mr. Victor Horsley² in an important paper describes his method of operating on the brain, and records three cases in which he operated successfully. The patient's head is rendered thoroughly aseptic the day before the operation, by being washed with soft soap and then ether, and covered with lint soaked in a 5-per-cent. solution of carbolic acid. The patient at the time of the operation is first injected subcutaneously with a quarter of a grain of morphia, and then chloroform is administered. The object of the

¹ 'Med.-Chir. Trans.' vol. lxxviii. p. 243.

² 'Brit. Med. Journ.' vol. ii. 1886, p. 670.

morphia is to cause contraction of the arterioles of the brain and minimise the amount of bleeding, and also to diminish the quantity of chloroform required to maintain anæsthesia. The operation is conducted under strict Listerian principles, including the spray. The skull is bared by a semi-lunar incision. The bone is removed by making a couple of trephine holes at the opposite extremities of the area to be removed, and then dividing the intervening bridge with Hey's saw and cutting bone-forceps. The dura mater is incised round four-fifths of the circumference of the area exposed at $\frac{1}{8}$ inch from the edge of the bone. The dura mater being raised, the first point to observe is whether the brain bulges into the trephine hole, denoting intracranial tension: the colour of the brain is also to be noted, since the existence of a slight yellowish tinge or lividity indicates the existence of a tumour beneath the cortex in the corona radiata. Exploration by vertical incisions may now be made, and if a tumour is discovered it is to be removed by a Volkmann's spoon or some such instrument. All oozing having been made to cease by pressure with a soft sponge, the flap is to be replaced, a drainage tube having been inserted, and united by suture. The wound is to be dressed, with firm but gentle pressure over the centre of the flap.

DISEASES OF THE LIPS AND MOUTH.

HERPES on the lip is one of the most familiar of all affections. It is generally held to indicate some slight disorder of digestion, but occurs really in conditions of perfect health. If it requires any treatment at all, slight purgation, the regulation of the diet, and mild mercurial ointments, are the appropriate measures. A very favourite ointment is gr. x.-xv. of the grey oxide of mercury to the ounce of lard. Herpes.

Fissures on the lips are closely allied to herpes, and are sometimes so persistent and so painful as almost to recall the fissures which occur near the anus. But they rarely if ever require incision. The local application which is most beneficial is the nitrate of silver in stick, with some mild mercurial ointment. Fissure.

The upper lip is frequently, and the lower lip less often, the seat of a general enlargement, due to struma, without any special deposit being perceptible. This affection is commonest in young women, and it requires no local treatment—as it will subside under the general treatment indicated for the constitutional disease; but I mention it here, as it excites the patient's alarm, and is to be diagnosed from tumour. The diagnosis is obvious if the surgeon is acquainted with the affection. ‘Strumous lip.’

The lips are very commonly the seat of nævus, which in ordinary cases is of the cutaneous or capillary variety, and then requires only the ordinary treatment—in fact, is often stationary, and requires no treatment at all. But in other cases the graver affection called aneurism by anastomosis occurs (more commonly, I believe, on the upper lip), as figured on page 359. The treatment of this disease is often very embarrassing. When it is small the best plan is to cut it out, and bring the halves of the lip together, just as for any other tumour. But when very large it cannot be thus dealt with, and then the red-hot wire introduced and made to cut through the mass—as by the galvanic cautery—is the best method of treatment; or the coronary arteries may be tied by turning the lip out, and the diseased tissue consolidated by the action of setons or electrolysis. Nævus.

Cancer is almost uniformly developed in the lower lip, though to this

Cancer of
the lip.

rule there are rare exceptions.¹ It is almost always of the epithelial variety, and often seems to be excited by the irritation of smoking a clay pipe. It is much more common in men than women. It is frequently complicated with enlargement of the submaxillary glands, and is often the seat of considerable pain. It slowly spreads to the tissues of the mouth; but it proves fatal usually by the secondary growth in the neck, and not by any symptoms caused by primary cancer. Its removal is urgently indicated. If the glandular affection, however, be only slight and recent, possibly the enlargement may subside after the removal of the original tumour; at any rate the surgeon is bound to give his patient the chance. The diagnosis is not usually difficult. The warty surface, the surrounding deposit of hard substance, and the persistent nature of the disease sufficiently distinguish it from all other affections, except perhaps chancre. Chancres on the lip are not at all uncommon, and, I believe, are often incurred innocently from accidental inoculation of a crack on the lip. In this case the patient can give no history of the origin of the sore, and when the disease arises from lascivious conduct he will give none, so that there is usually no assigned cause to assist in the diagnosis. But the surface of a chancre is less warty and irregular than that of a cancer; the hardness, if there is any (and not unfrequently there is little enough), is uniform, and extends a very little distance beyond the sore, and the bubo is earlier in its appearance than the malignant deposit in the submaxillary glands is. Chancres are equally if not more common in the female sex. Secondary symptoms will generally appear in six weeks or two months and settle the question, or the administration of mercury will speedily cure the sore.

Diagnosis
from
chancre.

In removing a cancer of the lip, if the disease spreads any distance from the edge, it is best to make a V-shaped incision, running entirely through healthy parts, and sew the two flaps of the lip together with the harelip suture. An assistant stands behind the patient's head and holds the two sides of the lip firmly, so as to prevent bleeding from the coronary arteries. A small stitch may be put in at the red edge of the lip to obviate any break in its line. When, as sometimes happens, the disease appears in the form of a deposit diffused along the border of the lip, but not spreading far into its substance, it is better to shave it off with a pair of curved scissors, and approximate the skin and mucous membrane with a few points of suture.

If a very large part of the lip requires removal the cheek must be liberated by curved incisions running round the alæ of the nose, when the flaps can be brought together, but, of course, with a good deal of tension and a most unpleasant 'underhung' look.

Other tumours, cystic and solid, are found in the substance of the lip, but there are no peculiarities here due to the seat of the tumour.

Ranula.

Ranula is a cyst, very analogous to a ganglion, found in the floor of the mouth and raising up the tongue. It is of a flattened form, something like the body of a frog, and is generally confined to the mouth. Sometimes it grows to a large size, and presents also under the jaw, forming a large swelling, which fluctuates from the neck to the interior of the mouth. It has in rare cases been observed to occur congenitally ('Lond. Med. Record,' 1877, p. 497).

Ranulæ are formed sometimes by the obstruction of one of the large sali-

¹ Mr. Venning and I related each a case of cancer of the upper lip in the 'St. George's Hospital Reports,' vol. vi.

vary ducts, as by a salivary calculus; at other times, as it seems, by the expansion of one of the processes of the sublingual gland; and probably at others by the independent formation of a cyst in the cellular tissue. The fluid contained in the cyst bears the strongest resemblance to that of a ganglion—i.e. it is a clear, yellowish, glutinous fluid, something like isinglass.

The tumour is troublesome from the interference it causes with the motion of the tongue and jaws.

It can in most cases be cured by simply making a free incision into it in the mouth, pressing all the fluid out, and taking care to keep the wound open by passing a director along it daily till the cavity has quite filled up. But it has often seemed to me better to take a piece of the mucous membrane out, by pinching up the wall of the cyst with a pair of clawed forceps and snipping out with the scissors a piece large enough to allow the end of the finger to be passed in. When this is done the cavity can hardly close till it is filled up. But the disease is sometimes obstinate, and then either a seton must be passed through it, or, after free incision, the cavity must be cleaned out and the lining membrane pencilled with nitrate of silver, or, if that is not strong enough, with nitric acid. In some cases of obstinate recurrence it is justifiable to attempt the complete removal of the cyst by dissection.¹

Those which project into the neck often contain cheesy matter, and are believed to be congenital dermoid cysts.² But I have seen some whose contents proved them to be true ranulæ. They must be opened by a free incision either in the floor of the mouth or in the middle line below the hyoid bone, which must be kept open till the cavity is obliterated.

Salivary calculi are chiefly seen in connection with ranula. They are small calcareous masses sticking out of and obstructing the orifice of one of the larger ducts—usually Wharton's. They require only a slight incision for their discharge. Salivary calculus.

The tonsils are subject to acute inflammation and abscess from various causes, as in scarlatina, in phagedæna after syphilitic sore-throat, in dissecting wounds, and 'hospital' sore-throat. But the disease especially denominated acute tonsillitis, or quinsy—Cynanche tonsillaris—is an affection allied to common cold, usually attacking persons who are out of health and somewhat predisposed to sore-throat. It often commences with rigors, stiffness, and pain at the back of the throat, and especial pain in swallowing. The whole of the back of the throat is red and swollen, and one side of the soft palate and the corresponding tonsil is especially swollen and red; the tongue is much loaded with a creamy fur, the saliva may run copiously out of the mouth, and in severe cases there is so much difficulty of breathing that the patient thinks himself in danger of suffocation. Gradually the parts around the tonsil soften, the colour of the matter becomes perceptible through the red membrane, and an abscess forms in the substance of the tonsil or in the cellular tissue around. This having burst, or being opened, the symptoms rapidly subside. It is rare for both tonsils to be affected at the same time, though not uncommon for one to be attacked after the inflammation in the other has subsided. Acute tonsillitis, or quinsy.

The treatment required is almost always somewhat stimulating, for the patient has generally been out of health and the pulse is low. Steaming the throat sometimes gives a good deal of relief; and a mustard emetic at the

¹ See Michel in 'Gaz. Hebd.' 1877.

² Fairlie Clarke, 'Diseases of the Tongue,' p. 217. Pollock, op. cit. p. 524.

commencement of the attack is often very beneficial. Gargling is very painful, and does little good. If any local application is advisable a mixture of mineral acid and honey applied with a brush seems best. When the patient suffers grievously from the swelling, yet no pus can be perceived, it is justifiable to make incisions or scarifications into the inflamed tissues, in order, if possible, to relieve the swelling and hasten the approach of pus to the surface; but care must be taken not to direct the point of the knife outwards, especially if the incisions are made at all deeply. If a knife is used its blade should be wrapped in lint to within an inch of the point, the patient's mouth should be widely opened in a good light, and the handle of the knife being directed outwards as it is entered into the tonsil or the parts near it, its point will incline towards the middle line. In this position, even if the patient should start, the large vessels around the tonsil can hardly be injured.¹

Sometimes, after the opening of an abscess in the tonsil, the opening becomes phagedænic, or other acute forms of sore-throat supervene; but this is very rare.

Putrid or sloughing sore-throat and diphtheritic affections are happily now rarely met with, except in epidemics, when they come more under the notice of the physician. I would refer the reader to works on Medicine.

Chronic enlargement of tonsils.

Chronic enlargement of the tonsils is an extremely common affection, generally due to constant irritation from cold and neglect in children of strumous constitutions, but occurring also in those who are well cared for, and not rarely in young women of weak health. As a general rule, when the affection is moderate in extent it is more troublesome than dangerous. But the enlarged tonsils are liable to constant attacks of sore-throat and ulceration; they spoil the voice; sometimes they (or rather the inflamed and thickened condition of the mucous membrane around them) impede the hearing; they prevent sleep except with the mouth open; and when extremely large in early life they may so obstruct the respiration as to produce a partial vacuum within the chest, and thus the pressure on the soft parietes of the thorax may much alter the shape of the chest.

Slighter cases may be left with confidence to constitutional treatment; as the health improves the enlargement will subside. But when the swelling is great the removal of the projecting part of the tonsil is urgently indicated, and affords the patient instant relief at the expense of only momentary inconvenience. When the enlarged tonsil projects fairly from the surface this little operation is most quickly performed with the French (or Charrière's) guillotine. This instrument terminates behind in a ring, into which the surgeon's thumb is inserted; at either side is another ring for his fore and middle fingers. The instrument consists of three parts—a base, or lowest stem, which ends in front in a ring, which is to be slipped over the tonsil; above this, and travelling in it in a groove, is another stem which ends in a ring, and the edge of this ring is sharp, so that as it is pushed forward it cuts off the part of the tonsil over which the instrument has been slipped; and above this again, also

¹ Severe and even fatal bleeding has occurred from incisions into the tonsil, possibly in some cases from the internal carotid itself, but certainly in most cases from the enlarged arteries of the gland. In such cases it has sometimes been thought necessary to tie the common or external carotid. But usually the bleeding may be stopped by firmly pressing a compress of lint steeped in perchloride of iron on the bleeding spot for some time. If the patient is too nervous or distressed to tolerate this without anæsthesia, ether or chloroform may be administered; and then, the mouth being held open with a gag in a good light, the bleeding spot will be well under command.

travelling in a groove on the base of the instrument, is a stalk, ending in the thumb-ring behind and in a double hook in front, and so jointed on to the base that as it is pushed forwards it rises away from the stem. In using this guillotine the surgeon sees first that it travels freely; then he draws all its parts well home, passes it into the mouth, where it serves as a spatula, gets the ring fairly round the tonsil, then by pushing his thumb forwards digs the double hook into the tonsil, and as he pushes his thumb on as far as it will go the double hook, rising away from the stem, draws the tonsil still farther into the grasp of the ring, and the knife-blade shaves it off. The whole affair is momentary and the pain very slight.

But when the tonsil is flatter and more irregular in shape it is better to seize it with a vulsellum and cut it off with a curved blunt-pointed bistoury directed from above, upwards and inwards, the blade being guarded with lint to within half an inch of its end.

Children, and other nervous persons who cannot be persuaded to open the mouth, may be narcotised, the mouth being kept open by Smith's gag (page 618).

There is not much bleeding after the removal of the tonsil, unless the surgeon has been more anxious to remove the whole mass than is at all necessary. All that is really required is to cut the surface off freely. The swelling is produced by obstruction of the orifices of the gland-ducts leading to a retention of epithelial secretion within them, which dilates the follicles and gives rise to inflammatory exudation into the cellular tissue. When the follicles have been freely cut across all this will subside.

The tonsil is sometimes, though not very often, the seat of primary carcinoma, more frequently of sarcoma. Occasionally epithelioma extends to the gland from neighbouring parts. The disease grows rapidly, and the patient's life seldom lasts more than about a year. The diagnosis, in the cases which I have seen, was obvious. No special treatment was employed, nor do I think that any operation is desirable. Attempts have been made by Mr. Bryant and others to remove the tumour from the mouth by means of an *écraseur*, but obviously this operation can hardly be efficient. Dr. Cheever of Boston¹ has twice removed the mass by external incision and a complicated operation in which the lower jaw was divided, but in both cases the disease soon recurred, and according to his own conviction the operation is one of very doubtful expediency.

Cancer and sarcoma of the tonsil.

Dr. Eliot records in the 'Am. Journ. of Med. Sci.,' July 1879, a case in which a sarcomatous tumour of the tonsil was removed, with at any rate temporary success. The rate of the growth, its diffusion into neighbouring tissues, and its accessibility would decide the propriety of the attempt.

Relaxation of the uvula is an affection very trifling in itself, but it produces distressing symptoms, such as constant cough and frequent vomiting, which when the cause is overlooked often needlessly alarm the patient. In many cases the relaxation is habitual, recurring on any trifling cold or disturbance of health. Painting with an astringent lotion (as glycerate of tannin or nitrate of silver), with purges and tonics, is sufficient in such cases. When the elongation is considerable and inveterate, the uvula should be taken hold of with clawed forceps and snipped off.

Relaxed uvula.

¹ 'Boston Medical and Surgical Journal,' Aug. 1, 1878. It appears from this article that the operation has also been twice performed in Germany, by Langenbeck and Hüeter. Neither case was published. The tonsil has been removed also by Mr. Golding Bird and by Mr. Lucas at Guy's Hospital ('Clin. Soc. Trans.' vol. xvi. pp. 9 and 14), but the results can hardly be regarded as satisfactory.

Alveolar
abscess.

'Alveolar abscess may be defined,' says Mr. Salter, 'as a suppuration around the fang or fangs of a tooth, usually carious, accompanied by absorption and expansion of the bony walls of the alveolus or alveoli, and the enlargement of the little pus-sac, the matter gradually finding its way to the surface either along a canal by the side of the fang of the tooth, opening at the edge of the gum, or through the gum itself at a point corresponding to the root or roots of the tooth implicated. When, however, the fangs are unusually long, or the reflection of the mucous membrane from the gum to the cheek or lip is very superficial, this same discharge may burrow still more outwardly and find its exit upon the surface of the face.' Mr. Salter, however, points out that the extension of an alveolar abscess to the external integument is limited in the upper jaw to those which are connected with the back teeth. Where the central teeth give rise to abscess which extends to a distance it burrows along the hard palate, and the lateral incisor is the usual source of this suppuration. In the milk-teeth it is rare for alveolar abscess to extend to a distance.

The common alveolar abscess, or gumboil, which points above the gum, either on its outer or inner side, is easily recognised and generally easily treated. If the tooth is so far diseased as to render its removal desirable, this is, of course, a radical cure. If the irritation is connected with stopping, the stopping should be removed; and if the tooth is to be preserved, free leeching and fomentation of the gum, combined with purgatives, will sometimes avert suppuration; but when matter has formed it should be early evacuated.

The difficult cases are those in which matter, having its origin in caries and suppuration around a tooth-fang, burrows to a considerable distance and appears as a sinus, usually with a protruding granulation, at a distant part of the face or under the chin. Such cases are constantly mistaken for cases of disease of the jawbone, though an attentive examination will show that there is no exposed surface in the jaw, and that there is a carious tooth surrounded by thickened and inflamed tissues. Such cases are aptly compared by Mr. Salter to cases of necrosis, the diseased tooth being, in fact, a sequestrum; and their treatment must be precisely the same, viz. the removal of the tooth, in doing which great care must be taken to see that it comes away entire, or, if not, that every fragment is afterwards removed.

Necrosis of
the jaws.

Necrosis attacks the jaws from various causes. In strumous disease, along with the caries of the teeth, to which strumous patients are so liable, portions of the jaw not unfrequently perish, and, becoming exposed in the mouth, give rise to a fetid discharge which poisons the breath, and in some cases is a source of real danger, from the cachexia which it induces. Necrosis, especially of the lower jaw, often follows fracture. But there is nothing peculiar in the pathology or treatment of such cases, except that the surgeon will be more anxious than in other regions of the body to extract the sequestrum early, in order to free the patient from the putrid odour which it causes.

Phos-
phorus
necrosis.

There is, however, a peculiar form of disease which affects the jaws, caused by the local action of the poison of phosphorus in persons who are exposed to the fumes of that mineral in lucifer-match manufactories. It has been abundantly proved that the disease is only generated in those who have carious teeth, and that it is caused by the acid fumes of the phosphorus (i.e. either phosphorus or phosphoric acid) dissolved in the saliva, and so applied

directly to the exposed alveolar process. The disease, therefore, might be prevented by seeing that all the workpeople had healthy teeth, and by the use of a mask in which the acid fumes would be stopped by passing the air through a sponge or some fabric saturated with a solution of one of the fixed alkalies or their carbonates. But the use of the amorphous phosphorus, which does not give off any such deleterious fumes, and which is now largely used to form the coating of the box on which the match ignites, has tended more than any such precautions to diminish the prevalence of the disease, which is accordingly now much more rare than it was some years since. The same consideration renders it inexpedient to devote much space to this subject.¹ The advent of the disease is marked by much suffering, and occasionally by considerable bronchial irritation produced by the fumes. The diseased periosteum swells up, and an enormous mass of spongy bone surrounds the sequestrum, especially in the lower jaw. The dead bone often takes long to separate, even after the teeth have come away, and when it is removed an enormous mass of bone is left to replace it. In some cases this new bone remains, and performs all the functions of its normal predecessor. Even when the whole lower jaw and both condyles have come away, the reproduced bone has been both useful and movable, being doubtless attached by ligament to the skull. In other cases the reproduced jaw, though exuberant at first, has withered away and left only a thin scar-like band, so that the patient has been permanently deformed.

The main indications of treatment are, first, to place the patient in a pure atmosphere and support the strength; next, during the process of separation to hasten it as far as may be, and liberate tension by as free incisions through the thickened periosteum as may seem prudent; then to remove the sequestrum at the earliest possible moment; and, finally, as Mr. Salter suggests, to adapt teeth to the reproduced bone, and endeavour by providing it with a function to avert the consecutive atrophy to which it is sometimes exposed.

Mr. Salter also likens to this phosphorus-disease the necrosis of the alveolar process which sometimes occurs after scarlet-fever and other exanthemata, and which he believes to be produced, as that is, by the application of the morbid poison to the jaw exposed by the presence of carious teeth. The gums, he believes, are affected in these cases in the same way as the skin is by the fever-poison; and thus, if the bone is exposed by caries of the teeth, the periosteum may become implicated. The question is one of much pathological interest, but its surgical bearings are the same as those of any other form of necrosis.

Exanthematous
jaw-necrosis.

Tooth-tumours, or 'odontomes,' are divided by Mr. Salter into (1) enamel nodules, or submerged cusps on tooth-fangs, which form small pearly tumours consisting of a thick tubercle of enamel, covered by enamel-pulp. These are of no surgical importance, and occasion no symptoms. (2) Exostoses, or over-development of the crista petrosa, which sometimes attains a size that requires removal; and this affection may attack one tooth after another, according to Mr. Salter, causing pain which will persist till all the teeth in one or both jaws have been extracted. (3) Hypertrophy, or dilatation of the fangs, which then differ only physiologically from exostoses. The symptoms

Tooth-tumours.

¹ I would refer the reader to Dr. Bristowe's report 'On the Manufactories in which Phosphorus is Produced or Employed,' 'Fifth Report of Med. Off. of Privy Council,' 1863; and to Mr. Salter's article in the 'Syst. of Surgery.'

they cause are the same, and they equally demand extraction. (4) Dentine excrescences growing from the dentine into the pulp-cavity, and producing constant and severe neuralgia, which requires the extraction of the teeth. The disease cannot be recognised till after removal. (5) Warty teeth, the 'dentinal odontomes' of Broca, in which one or more teeth are affected by a large lobed warty tumour growing from some part of the tooth either into the mouth or into the substance of the jawbone, and composed of a confused mass of bony structure and dental tissues. The chief importance of a knowledge of these tumours is to avoid the removal of the bone in such cases, for the simple extraction of the tooth along with the tumour will be sufficient; but if the growth has been allowed to attain extraordinary size the diagnosis may be difficult.

Finally, it will suffice just to mention the polypous tumours which grow from the tooth-pulp, either in caries or after the fracture of a healthy tooth. The chief surgical importance of the latter subject is that such fracture of a tooth is common in fractured jaw, and that the growth of this polypous tumour from the pulp, which is acutely sensitive, may prove a most troublesome complication, unless it is detected and the tooth removed.

TUMOURS OF THE JAWS.

Tumours of the jaws are best described as cystic and solid, innocent and malignant.

Tumours of the jaws.
Cysts. The true cystic tumours in the bone are more common in the lower than the upper jaw, and are often, if not always, the consequence of irritation around the sac of a tooth which has been misplaced or ill-developed. In many cases the connection is rendered obvious by the fact that the wall of the tumour contains one or more teeth more or less imperfect and more or less misplaced, and to these tumours the name of 'Dentigerous Cyst' is properly applied; but in other cases the connection between the cyst and the teeth can only be a matter of inference. The misplaced tooth has always been one of the second set, except in a single instance recorded by Mr. Salter, where a similar tumour formed around a tooth said to be a milk molar. Small cysts are also found in connection with the fangs of perfect teeth.¹ The diagnosis of dentigerous from other cysts of the jaw can be made approximately by observing the absence of the tooth, and absolutely by incision into the cyst, when the tooth will be found and should be removed. This will generally be followed by the filling up of the cavity.² In other cases multilocular cysts have been found, i.e. tumours in which the main cavity has been divided by septa into two or more secondary spaces, and others which would be more correctly described as a congeries of small independent cysts. Finally, there are cases of cystic sarcoma—i.e. cases in which a large cyst is formed in the substance of a tumour which is itself more or less malignant.

Cysts of the antrum. The subject of cysts of the antrum and dilatation of that cavity is so

¹ See Heath, 'On Diseases and Injuries of the Jaws,' 2nd ed. p. 160.

² An interesting case of dentigerous cyst of the lower jaw is reported in the 'Chicago Medical Journ.' for Jan. 1884, by Dr. J. S. Marshall, in which an inverted wisdom tooth was impacted in the base of the condyloid process at its junction with the ramus and coronoid process. The irritation and suppuration around this had produced necrosis of the whole of that portion of the bone, including the condyle, and the whole of this necrosed bone was removed along with the tooth. It was, however, entirely reproduced, and the movements of the jaw were ultimately quite natural.

closely connected with that of cystic tumours of the jaw, that although such cases hardly come logically under the designation of tumours of the jaw—and some, in fact, are hardly to be styled tumours at all—I must treat of them in this place.

Most of these cases of dilatation of the antrum appear to be due to the development of cysts in the substance of the lining membrane, as was long ago pointed out by Mr. W. Adams and M. Giraaldès,¹ the cyst being formed by the dilatation of one of the crypts of the mucous membrane. In some cases such cysts are very numerous, and then do not generally increase much, but in others they are single, and their constant increase may lead to the suspicion of a tumour of the jaw, and even (in one lamentable case referred to by Mr. Heath) has occasioned the total removal of the jaw. Usually, however, they are easily distinguishable from cancer or any other solid tumour, and they are spoken of as dropsy of the antrum, and used to be regarded, before the publication of Mr. Adams's and M. Giraaldès' researches, as uniformly due to inflammatory distension of the entire cavity, sometimes followed by suppuration or abscess of the antrum. And it seems certain that such general irritation followed by abscess does exist in some cases, being in all probability caused by morbid action around the fangs of the bicuspid, canine, or first molar tooth, which are in close proximity to the lining of the antrum.² The symptoms, then, of a large cyst developed in the antrum are identical with those of dropsy of the antrum,—that is to say, general distension of the upper jaw below the orbit, with some aching pain, and a sensation of yielding or perhaps positive crackling on pressure above the alveoli; sometimes, also, purulent or other fluid exudes into the mouth on pressure, and in cases of abscess the distinctive symptoms of suppuration may have been noted.³

Dropsy
and abscess
of the
antrum.

The treatment of cysts and that of dropsy of the antrum is at first the same, namely, to make a dependent opening, by drawing one or more teeth if they are carious or loose; or, if the teeth are sound, but the bone much thinned above the alveoli, to make a tolerably free incision through the wall of the antrum in that position, and then to keep the cavity syringed out with some disinfectant, of which perhaps Condyl's fluid diluted is the best. Simple dropsy and abscess will yield to this treatment; but if the enlargement is due to a cyst it may be necessary to enlarge the opening sufficiently to scrape out all the tissue connected with the cyst or cysts. The total removal of the upper jaw can never be required.

The other cysts in the lower or upper jaw require free incision, the removal of any misplaced teeth which may be found in their interior, and the approximation of their walls by well-adapted pressure of pad and bandage. The opening into the tumour must always be kept perfectly free, and stimulating injections are thought sometimes to hasten the closure of the cyst. Removal of the jaw has been practised in these cases,⁴ and it might perhaps become necessary if the simpler operation failed to give effectual relief; but it is generally unjustifiable. A sufficiently free opening can almost always be obtained in these cases from the interior of the mouth.

Cystic
tumours of
the jaws.

¹ Heath, *op. cit.* p. 156.

² On the Anatomy of the Antrum, see Salter, in '*Syst. of Surg.*' 3rd ed. vol. ii. p. 465.

³ In very rare cases (three are referred to by Mr. Salter, *op. cit.* p. 466) abscess of the antrum has caused amaurosis, the sight returning on the relief of the abscess.

⁴ As in a celebrated case operated on by Sir B. Brodie, and figured in '*Syst. of Surg.*' vol. ii. p. 528, 3rd ed.

I ought to add that care must be exercised in the case of any supposed solid tumour of the jaw which is at all elastic, to make sure that it is not of the cystic variety, for many cases are on record in which, after extirpation of the jaw, the surgeon has been shocked to find that he was dealing with a simple cyst with somewhat thick walls, and therefore that the patient could have been cured without any mutilation. The condition of the teeth also should be carefully studied. And, finally, the opposite mistake should be avoided, of taking for a simple cyst that which is only a cystic formation in a solid tumour. The majority of such cyst-bearing tumours will be malignant clinically, though perhaps anatomically to be reckoned among the sarcomata.

The solid tumours of the jaws may be divided into the innocent and the malignant.

The innocent tumours will be subdivided into fibrous or fibroid, cartilaginous and osseous.

Epulis.

The most familiar of the fibroid growths are called epulis, from their position just above the gums. These are either purely fibrous, or, as is frequently the case, mixed with myeloid elements. The first class are unquestionably innocent; the latter, like the other sarcomata, are of a more suspicious character—i.e. they may recur locally—but they are hardly of a truly malignant or cancerous nature. To this rule I have, however, seen two exceptions in which epithelioma occurred in the situation of an epulis. Epulis has its root just above the teeth, and frequently from the lining membrane of one of the alveoli; at other times it makes its appearance at some distance from the alveolus, usually on the exterior, in rarer cases in the cavity of the mouth; but in these cases also Mr. Salter¹ suspects that the tumour is connected primarily with the periodontal membrane; and even in cases where an epulis forms on a jaw apparently edentulous it will be found, according to Mr. Salter, that some fangs of teeth have been left behind. Epulis is more common in the upper than in the lower jaw, the proportion being fixed by the same author at about two to one.

The treatment of epulis consists in its removal, along with the tissue from which it springs, i.e. the periodontal membrane, or the lining of the alveoli. Very often the growth of the epulis has completely displaced the teeth, and in such cases all that will be necessary is to cut the tumour freely away from its base and rasp the latter away from the subjacent bone with a strong knife. This will cut away all the alveolar tissue, and the periodontal membrane, if any is left, will atrophy, and so the whole tissue from which the tumour springs will ultimately have been removed, and then no recurrence need be feared. If the teeth have been left at the first operation and recurrence takes place, which is tolerably often the case, the surgeon must be careful to remove them at the second, and the cure will probably then prove permanent. But in inveterate cases, after the removal of the teeth, it is necessary to clip away the bone to some extent with curved cutting-forceps, so as to make sure of having removed the whole of the alveolar portion of the jaw; and if any doubt exists on this point, or if suspicious-looking granulations sprout from the wound, some strong caustic (of which the pure nitric acid is the best) must be unsparingly employed. Under such treatment a definite cure may be confidently promised.

Fibrous and cartilaginous or fibro-cartilaginous tumours also spring from

¹ 'Syst. of Surg.' 3rd ed. vol. ii. p. 455.

the body of the bone unconnected with the teeth. The antrum is the favourite seat of the purely fibrous tumours, and here they often extend widely in all directions. But it must be recollected that in many of these cases, as in Sir P. Hewett's case ¹ (quoted by Mr. Pollock, 'Syst. of Surg.' 3rd edit. vol. ii. p. 531), the growth which has been taken for a tumour of the antrum really springs from the base of the skull—a point which will be hereafter again alluded to. Fibrous tumours are also found springing from the interior of the skull and expanding the bone around them. In one curious case, referred to by Mr. Pollock, in the Museum of St. George's Hospital, there is a nucleus of bone in the centre of the tumour; and in another, which Mr. Heath describes, in the College of Surgeons' Museum, the tumour is calcifying like a uterine fibroid.

Fibrous
tumour of
body of
bone.

The diagnosis of these fibrous tumours from others which are of a softer consistence and of a more malignant character rests on their slow growth, their regular rounded outline, especially in the lower jaw,² and their firm, uniform consistence. They may bleed to a certain extent³ from the constant irritation to which they are subject.

When a truly fibrous tumour is entirely removed along with all the bone from which it springs, it will not recur. The numerous instances on record of recurrence after operations of this nature have depended, no doubt, on the fact that the tumour was not purely fibrous, but sarcomatous in part; or in some other cases on imperfect removal. In operating on a fibrous tumour, therefore, it is desirable to cut wide of the tumour, and, whenever it is possible, to remove the whole of that part of the bone from which the tumour springs.

Cartilaginous tumours are rare, but they sometimes attain an immense size. Mr. O'Shaughnessy removed a fibrous enchondroma from the upper jaw which was nearly as large as the patient's head, and overlapped the lower jaw, which was contained in a groove on the lower surface of the tumour. (Heath, p. 243.) In the Museum of St. George's Hospital is an enormous mass of enchondroma (Ser. xvii. No. 66),⁴ which implicates the upper jaw, but is chiefly connected with the base of the skull. A few other cases of a similar nature are recorded, and one was operated on by Mr. Morgan, of Guy's Hospital, with some success. Mr. Moore, however, in an attempt to remove such a growth, found the disease to be myxomatous, and the patient died on the table.

Enchondroma.

Exostosis of the jaws is often of the ivory variety, as in the cases figured on pp. 459, 460—the former from the lower, the latter from the upper jaw. For the main considerations relative to their treatment I would refer the reader to that place.

Exostosis.

The malignant forms of solid tumour in the jaws are sarcomata and carcinomata; the former are often mixed with cysts, the solid matter being usually of the round or spindle-celled variety. Myeloid tumours are more common in the form of epulis than as diseases of the body of the bone, and are usually innocent; though to both rules there are many exceptions. Cancerous tumours are usually, if not always, epitheliomata—either squamous epithelioma springing from the gum or spreading from neighbouring parts, or else columnar epithelioma originating in the nasal fossæ or antrum.

Malignant
tumours.

¹ 'Med.-Chir. Trans.' vol. xxxiv. p. 43.

² The fibrous tumours of the antrum consist of a great number of large lobes which pass into all the spaces communicating with that cavity.

³ Pollock, op. cit. p. 532.

⁴ See also 'Path. Trans.' vol. x. for a description of this case, with a drawing.

These forms of tumour of course demand complete and free removal if seen early enough; but the prognosis is highly unfavourable. In all cases that I have had the opportunity of watching recurrence has taken place very early.

It appears probable, from cases recorded by Mr. Wagstaffe and Mr. Heath,¹ that in some of these cases of cystic sarcoma the disease 'commences in the mucous or submucous glands of the gum and cheek, and only subsequently invades the jaw.' Mr. Heath refers to a case under Mr. Skey's care in which the outer wall of both the upper and lower jaws was involved. The disease was freely cut away, and the patient made a good recovery.

Tumours of
the
antrum.

Any of these forms of tumour may originate in the antrum of Highmore. Some tumours of the antrum are purely fibrous; others, no doubt, glandular or adenomatous—i.e. morbid imitations of the glandular tissue of the mucous membrane lining the antrum. I have already referred to the existence of exostosis in the antrum, and the occurrence of malignant tumour is unluckily only too common.

The diagnostic sign of a tumour having its origin in the antrum is that it expands the wall of that cavity in various directions, so as to invade several of the spaces with which the antrum is in relation. It presses laterally into the nostril, downwards into the mouth, upwards into the orbit, backwards into the pharynx or pterygo-maxillary fossa, and outwards into the zygomatic and temporal fossæ, and very commonly in many or all these directions at once. A tumour, however, growing from the base of the skull may so envelop the upper jaw as to grow in several of these directions, as exemplified by Sir P. Hewett's case above mentioned; so that the diagnosis should not be arrived at without careful examination.

The origin of a tumour from the antrum is a matter of importance, because then the surgeon may be confident of removing the whole of its attachment. The complete excision of the upper jaw removes every part of the antrum, and is therefore much more satisfactory than operations on tumours of the base of the skull can ever be.

Operations
on the
jaws.

The upper jaw may be removed either partially or entirely. In the partial removal the orbital plate is left behind, while in the other operation not only the entire maxilla, but, if it is wished, the malar bone also, may be excised. The plan formerly in use was to make two incisions, one somewhat vertical from the inner angle of the orbit, coasting round the nose, and dividing the lip in the middle line to its free edge; the other sloping down from the malar prominence (or from the zygoma if the whole malar bone also is to be removed) to the outer angle of the mouth. But these extensive incisions are rarely required. A single cut running under the lower border of the orbit, and embracing more or less of the extent of that cavity as may be thought necessary, and extending from thence along the outer side of the nose through the upper lip, enables the operator to turn back as large a flap of the cheek as is ordinarily requisite; one or two of the front teeth should be drawn at the commencement of the operation. Then the two upper jawbones are separated from each other by a cut with the saw or bone-nippers along the hard palate, the ascending process of the superior maxillary bone is cut across, and the malar divided from the superior maxillary by notching it with the saw and then completing the division with the forceps. Now, on twisting the bone with the lion-forceps it will become loose, and is to be severed from the soft

¹ Wagstaffe, 'Path. Trans.' vol. xxii.; Heath, op. cit. p. 303.

palate and its remaining attachments with the knife. In doing this the terminal branch of the internal maxillary artery is divided, but as there is now a large and free opening there will be no difficulty in securing it. The large gap is to be sprinkled with iodoform crystals, filled with a piece of dry lint, and the soft parts united with numerous sutures and a harelip pin or two. Recovery is generally rapid. A large gap will be left in the mouth, which must be filled up with an obturator.

If only the body of the bone is to be removed, the orbital plate being left, after severing the ascending process of the superior maxillary bone, the cut is to be extended outwards, with a keyhole saw or cutting-forceps, beneath the orbit, until the whole of the wall of the antrum has been separated from its roof, and then the loosened bone is to be twisted out with the lion-forceps. This operation is used chiefly to obtain access to the base of the skull in the case of fibrous naso-pharyngeal polypus. The end is attained with less deformity than if the entire bone be removed.

Finally, Langenbeck has devised an operation in these cases which he denominates 'the osteoplastic resection of the upper jaw.' Instead of removing the soft parts from the jaw, 'the requisite incisions are made down to the bone at once, the bone is sawn through in the same incisions, and the portion

Partial removal of upper jaw.

Langenbeck's osteoplastic resection of upper jaw.

thus forcibly detached turned inwards, without otherwise dividing it from its connection with the nasal and frontal bone. The tumour is then removed from behind the bone, and the latter replaced in its original position. No incision is made at the place where this bending or fracture must necessarily occur.' (Pollock.)

I must refer the reader to the original ('Deutsche Klinik,' 1859 and 1861) for details as to this plan of treatment. It has not commended itself to surgeons in this country, nor do I believe that it is now in much use anywhere.

Operations on the lower jaw may be conducted entirely inside the mouth if only a portion of its thickness is to be removed; but when any part of the whole depth of the bone is to be taken away an external incision will be required.

Removal of lower jaw.



FIG. 294. Sarcoma of the lower jaw. From a preparation in which the entire half of the lower jaw was removed for a rapidly growing periosteal sarcoma, which extended far down the neck. The man made a rapid recovery; but the disease soon recurred, and he died within half a year.—St. George's Hospital Museum, Ser. ii. No. 66d.

The whole of one side of the lower jaw may be removed by making an incision through the middle line of the lower lip and along the lower border of the jaw to the situation of the articulation, denuding the anterior surface of the bone and tying the arteries, sawing through the bone in the middle line, cutting the muscles

and mucous membrane away from its inner surface, then seizing the bone with the lion-forceps and twisting it out so as to dislocate it from the skull, any remains of the ligaments being touched with the knife, which is kept very close to the bone in order to avoid the internal maxillary artery. In this, as in all other extensive operations on the lower jaw, the tongue should be commanded by a stout ligature passed through it before the operation is begun, otherwise the patient may be in danger of suffocation from its falling back over the entrance to the larynx. If it is necessary to remove

the whole jaw, the same operation may be repeated on both sides, or the incision through the middle line of the lip may be dispensed with, the whole of the lower lip and lower part of the face being turned off the bone by a free incision from one side to the other, after which the bone is divided in the centre and its two halves dissected out as before. The difficulty and danger of the operation in cases of rapidly growing tumour are often chiefly in dealing with the cervical part of the growth, as it was in the instance here figured (Fig. 294).

Anæsthesia
in opera-
tions on
the jaws.

In all operations on the upper and lower jaw which involve extensive incisions, and therefore danger of formidable hæmorrhage, the surgeon must remember that anæsthesia involves a certain amount of danger. I have, it is true, removed the whole upper jaw frequently under anæsthesia without any bad symptoms, and have seen the operation so performed by many other surgeons; yet the reality of the danger is testified by Sir Prescott Hewett's well-known case,¹ and another which occurred not very long since at St. George's Hospital, in both of which death was attributed, with at any rate much probability, to the entrance of blood into the air-passages while the patient was unconscious. So strongly do some surgeons feel the danger of anæsthesia in such cases that they prefer to perform tracheotomy as a prelude to removal of either jaw under anæsthesia. This is not, I think, absolutely necessary, but in any case where the patient has the necessary resolution I much prefer to perform the operation without an anæsthetic; and I have met with three cases, under the care of Mr. Tatum, Mr. Haward, and myself, in which the patients have had the operation performed sitting in a chair without making any complaint or embarrassing the operator in any way.²

Closure of
the jaws.

Finally, I must say a few words about that very troublesome affection which consists in permanent closure of the jaws. In rarer cases this is caused by ankylosis of the temporo-maxillary joint, but more commonly by the destruction of the mucous lining of the mouth by sloughing from cancrum oris or mercurial poisoning, by phagedænic or by lupoid ulceration, and the substitution for it of a cicatricial tissue, which will go on for years contracting more and more tightly, and in which bone is sometimes developed. In the slighter cases of this cicatricial contraction, as in other cicatrices, it may be possible to stretch the cicatrix and keep it stretched by mechanical means, just as is done in contractions of burns. But when the contraction is formidable I have never seen this plan successful. Two operations have been proposed for the partial relief of the painful consequences of this infirmity, by establishing a false joint in the lower jaw. One (Rizzoli's) consists in dividing the jaw from within the mouth with a fine saw, and preventing the union of its segments either by constant motion or by inserting a piece of guttapercha between them. This, however, is now rarely practised, being apparently less efficient than Esmarch's plan of dividing the jaw by an external incision in front of the cicatrised part and taking a wedge-shaped piece out of it. This operation, if practised fairly in front of the cicatrix, is said by Mr. Heath to yield good and permanent results. Or attempts may be made to divide the tissues between the bones, and screw the bones apart by instruments applied between silver shields moulded to the upper and lower jaw.

In contraction from ankylosis the ramus of the jaw should be divided with

¹ 'Med.-Chir. Trans.' vol. xxxiv. p. 43.

² In my case (referred to on p. 648) the operation was repeated again without any anæsthetic.

a fine saw as near the joint as is found practicable, and a small piece removed. This can be effected without external incisions.

I must refer the reader to Mr. Heath's work for a full description and discussion of these rare and somewhat unsatisfactory cases.

DISEASES OF THE NOSE.

THE diseases of the nose are divided naturally into those of the external parts—the skin and cellular tissue; and those of the interior—the bones, cartilages, and mucous membrane.

The commonest affection of the external parts of the nose is that to which the name of *Acne rosacea* is generally applied, though the name may not be an exactly appropriate one, true acne being considered to be in all cases an affection of the sebaceous follicles: while in *acne rosacea*, though the sebaceous follicles may in many cases be affected, in others they certainly are not. The disease in its simple form consists in an injection of the capillaries of the skin, which produces a red, shiny, greasy appearance, in some cases limited to the tip, at others extending over the whole of the organ. The sebaceous follicles may be also affected, and in those cases the skin is marbled and irregularly knobbed. The simple form of acne is more common in women than in men, and is generally developed about the cessation of menstruation, with which function it seems to have some unexplained connection. In the male sex it may be referred to disorders of digestion, exposure to the weather, or other sources of ill-health, but seems to have no necessary connection with intemperance. The acne 'hypertrophica,' 'spirit-drinker's nose,' vulgarly 'grog-blossoms,' is a severer form of the same complaint, due to the abuse of wine or alcohol, in which the sebaceous glands are always much affected, and which is followed by enormous hypertrophy, producing the pendulous masses called *lipoma*, which are so familiar in old toppers.

Disease
of the
external
parts.

Acne
rosacea.

Lipoma
nasi.

In all cases of acne the first care of the surgeon is to ascertain if possible whether any inordinate indulgence in the pleasures of the table has given rise to the disease, or whether it is connected with any obstruction to the menstrual discharge, and to counteract such deleterious agencies by gradual and judicious treatment. Local applications are numerous, and are chiefly of the stimulating kind. Hot bathing of the part, followed by the application of a lotion of the perchloride of mercury, one or two grains to the ounce, is said by Mr. Durham to be efficacious in the milder cases. Soaps of carbolic acid, or some salt of sulphur, or pastes of these substances laid on the parts overnight and washed off in the morning, or ointment of iodide of sulphur, may be tried in more advanced cases. In obstinate cases Hebra recommends longitudinal incisions to be made through the hypertrophied parts, and after the bleeding has somewhat ceased the surface of the incisions to be brushed over with liq. hyd. perchloridi. But when the pendulous masses called *lipomata*¹ are developed, nothing short of their extirpation will do any good, and the operation is often quite successful, though in patients of this kind erysipelas and other complications are of course to be apprehended. The best plan is to make a free median incision, and others at the sides, turning flaps down sufficient to cover the framework of the nose without any tension, remove

¹ The name is so far inappropriate that the tumours are not fatty, but consist of hypertrophied skin and sebaceous follicles with connective tissue.

the intervening mass, and unite the flaps. Care must be taken not to open the interior of the nose by cutting through the cartilages, to avoid which the left forefinger must be kept in the nostril.

Lupous
and rodent
ulcers.
Cancerous
diseases.

The nose is peculiarly subject to the forms of ulceration spoken of at p. 422 as lupous and rodent ulcers, but I need add nothing here to what is said there and in the chapter on DISEASES OF THE SKIN on that subject. Epithelioma also is not uncommon at the angle of the nose, and should be early and freely removed with the knife, caustic being applied to the section if any tissue in it looks suspicious.

Malforma-
tions.

Congenital absence of the nose has been recorded, and it has even been said that plastic operations have been performed for its cure; but I confess that I do not understand how any surgical operation could restore anything like the natural appearance in such cases.¹ But in cases (which are also very rare) of congenital occlusion of one or both nostrils, or of adhesion between the nostril and septum, an operation may be of the greatest service, and should be at once undertaken, since the obstruction much interferes with sucking. The obstruction is sometimes merely membranous, while at other times a considerable depth of tissue has to be penetrated. A free opening into the nasal cavity should be secured, and kept permanently dilated by means of a metal or gum catheter retained for many weeks, and the case should be watched to prevent recontraction. Similar in principle should be the treatment of occlusion or narrowing, the result of cicatrisation, the usual cause of which is lupus; but here the prospects of cure are far less encouraging, since the tissue of the cicatrix tends to recontract. The constant expansion of tents of laminaria may, however, ultimately overcome this tendency, if the patient will persevere.

Cicatriza-
tion.

Deviations.

Deviations of the nose are very common to a slight and hardly perceptible extent. But sometimes, whether as the result of injury or as a congenital formation, the septum inclines so much to one side as almost to close one nostril, while the turbinated bone on the opposite side projects so much into the other as to be mistaken for a tumour. A little attention will enable the surgeon to avoid this error and explain the nature of the case; but no treatment has as yet, I believe, proved successful, though removal by the knife of a portion of the cartilaginous septum is recommended by Professor Gross.

Affections
of the
interior of
the nose.

The examination of the nasal cavity may be made from the nostril, for which purpose special instruments are contrived, such as Fraenkel's nasal speculum or Cresswell Baber's dilator, figured by Mr. Haward (*Syst. of Surg.* 3rd ed. vol. ii. p. 632); but for many cases the spoon end of a director, or a couple of directors, introduced on opposite sides, will serve well enough: or the nose is examined by means of careful probing—very necessary in the search for foreign bodies: or by reflected light from the mouth, by which the posterior nares may be illuminated, as will be explained in speaking of Laryngoscopy, of which this examination, 'Rhinoscopy,' is a variety. It is a very difficult method of examination, but has afforded useful results in cases of foreign bodies impacted in the respiratory pharynx, and in tumours situated near the posterior nares.

Rhino-
scopy.

¹ See Holmes's 'Surg. Dis. of Childhood,' 2nd ed. p. 128.

I have already spoken of foreign bodies in the nostril (p. 184), and of the importance of detecting and extracting them at the earliest possible moment. Such bodies sometimes attract inspissated mucous and purulent secretions, and thus form the nuclei of rhinolithes, or nose-stones, which are found, though rarely, in the inferior meatus, while at other times, as it seems, such concretions form without any foreign nucleus; and in any case of constant discharge and inflammation, for which no cause is obvious, it is important to examine the meatus thoroughly for one of these concretions. When detected it must be removed entire if possible; otherwise it can probably be crushed with a tolerably stout pair of forceps, and the fragments extracted or syringed out.

Rhino-
lithes.

Epistaxis, or bleeding from the nose, is a very common affection, both in youth and old age. It occurs in consequence of injuries, though rarely to any great extent. In fractures of the base of the skull, as pointed out above (p. 151), it is sometimes copious and persistent. But the epistaxis which is usually the subject of treatment is spontaneous. In youth this is rarely of much consequence, except in persons the subjects of the hæmorrhagic diathesis. Any slight congestion will induce epistaxis in some children, but it will almost always subside. There are many ways of treating it in popular use, and their success is generally to be explained by the spontaneous cessation of the discharge. Cold to the spine, as by dashing cold water on the nape, or 'the nursery remedy of slipping a cold key down the back,' or raising the arms vertically above the head, certainly seem to stop the bleeding. But the direct application of cold, as by washing out the nose with ice-cold water or passing pieces of ice into the nostril and applying ice-cold lotion to the forehead, is still more efficient, and sometimes the injection of tinct. ferri perchlor. diluted is very serviceable.

Epistaxis.

In young women epistaxis is sometimes vicarious when the menstrual discharge is suppressed, and then requires no treatment except that which is directed to the re-establishment of the natural function.

In fevers and scurvy epistaxis is liable to occur, and sometimes can only be suppressed by plugging the nose.

In advanced life epistaxis is often indicative of cerebral congestion, and in such cases must be regarded with anxiety, though in itself and for the time, if not excessive, it will probably avert graver mischief.

Obviously, then, the treatment will depend on a knowledge of the cause, and as a general rule there is little occasion for any violent attempt at suppressing the hæmorrhage. It usually subsides of itself, having done only good. If it seems necessary to suppress it by surgical means, a free washing out of the nose by the method to be presently described as Dr. Thudichum's, with ice-cold water, or with some astringent solution, hardly ever fails to stop it, except in the case of the depravation of the blood by the hæmorrhagic diathesis, or by fever or scurvy, in which cases and in some of the more violent hæmorrhages of later life it may be necessary to plug the nares.

Plugging the posterior nares may be effected by means of Bellocq's Sound, here figured. The sound is hollow, and carries a stilet of spring wire on a handle. The stilet has a large eye at its end. It is introduced along the floor of the nostril into the pharynx, and then by pressure on the handle the stilet is made to protrude, and curves round the soft palate into the mouth. The eye is drawn out as far as it will come (Fig. 296), and the string on which the plug is fastened is then passed into the eye, and by with-

Plugging
the nares.

drawing the instrument the string is brought out of the nose. There is then nothing to do but to draw the plug up to the posterior nares. The plug should be fastened in the middle of a long piece of string. It should be made of lint or sponge, and its size should be that of the first joint of the patient's thumb, which is a little more than the size of the posterior nares, so that the plug cannot be drawn into the nose. When lodged in the posterior nares there are two ends, one projecting from the nose, the other from the mouth. On the one which projects from the nose a plug should be strung, which fills the anterior nares, and on this the thread should be firmly tied, so that both plugs are kept securely in position. This is best done by sewing the string into the substance of the plug and making all fast with a secure knot. If both nares are plugged the strings should then be tied together. The other string which emerges from the mouth is to be left loosely tied to the anterior string, or secured on the cheek with a piece of strapping, so as not to irritate the soft palate. It is very useful in withdrawing the plug. If Bellocq's Sound is not at hand a soft gum catheter is to be



FIG. 295. Bellocq's Sound.



FIG. 296. Plugging the nares.

taken and perforated opposite its eye, so as to make it into a gigantic needle. This is passed through the nose into the pharynx, and its end is caught there, brought out of the mouth, and threaded. The plugs are very inconvenient to the patient, especially when, as is usually the case, both nostrils require plugging, since he can only sleep with his mouth open, and the strings are very much in the way. They may be removed in about two days. The anterior plug being removed, an interval of an hour or two may be given to see whether any bleeding persists. If not, by cutting the anterior string and drawing on the posterior, the plug is at once removed from the posterior nares.

It must be allowed that this is a most unpleasant proceeding for the patient, and not always an easy one for the surgeon. My friend Mr. Howard has lately introduced into practice a much simpler contrivance, which, I believe, is usually effective. It consists of a bag of peculiar shape, to adapt itself to the nasal cavity when dilated, which is introduced by means of a probe or director through the anterior nares into the pharynx, and is then blown up, and the air confined by means of a stopcock which rests outside the nostril. If both nares require plugging it can be done on both sides. The bag keeps itself in its place, is introduced and withdrawn in a moment, and gives the patient the least possible amount of inconvenience. Other persons seem to have invented contrivances somewhat similar, but Mr. Howard's seems to me the best and most handy.¹

¹ 'Brit. Med. Journ.' 1881, vol. ii. p. 896.

Chronic coryza is a troublesome complaint, which sometimes lasts for years or for life, producing no ozæna or other unpleasant symptoms beyond catarrhal discharge and loss of the sense of smell. In other cases, and especially in strumous children, the mucous membrane becomes chronically thickened especially over the end of the inferior turbinated bone, giving at first sight the impression of a polypus, and being very often mistaken for one, though most easily distinguished from it by the absence of any stalk, by the immobility of the thickened membrane, and by its red, opaque tint.

Chronic thickening of the pituitary membrane.

The treatment of these chronic affections of the pituitary membrane is difficult. When the chronic thickening is obviously connected with struma the constitutional cachexia must be treated more than the local disease, though the persevering application of astringents and stimulants either in powder, lotion, or pulverised and injected into the nostril, seems often to do good. I have seen cases where it has seemed to me that the mistake of taking the thickened membrane for a polypus and tearing part of it off has done good instead of harm, though I should not venture to recommend the practice.

There are cases at first sight nearly resembling chronic coryza, and doubtless often classed as such, which are caused by the presence of adenoid vegetations in the naso-pharyngeal cavity. They are most commonly met with in scrofulous children, and are frequently associated with chronic enlargement of the tonsil. They are rarely found in adult life, and consist of out-growths of the normal lymphatic tissue of the mucous membrane of the pharynx. The symptoms to which they give rise are nasal obstruction and deafness. The child will be noticed to invariably keep its mouth open and to breathe with a peculiar snoring sound. The lips will be dry and cracked, or glazed. The voice will be dull, and often nasal. The nose will present a pinched aspect, and the alæ will appear to be compressed or narrowed from side to side. The child will be deaf, and probably from this will present a stupid, vacant, lifeless expression. Upon examination, semipurulent discharge will often be found clinging to the back of the pharynx, sometimes tinged with blood; and in advanced cases the soft palate may be noticed to be more prominent and fixed than usual. The disease is one of considerable importance, since it leads to impairment of the general health, to frequent sore-throat, to a tendency to bronchial affections, and to permanent deafness from obstruction of the Eustachian tube. Several plans have been advocated for the removal of these growths; all, however, based on the same principle, of scraping them off the back of the pharynx. Loewenberg recommends suitably curved forceps with cutting-blades, which are introduced through the mouth and passed up behind the soft palate. Meyer used a flexible ring knife passed through the nares into the pharynx, guiding its movements by the forefinger of the left hand, introduced through the mouth. Sir Wm. Dalby employs a mechanical fingernail, constructed of steel, and fixed to the index finger, introduced through the mouth, with which he scrapes away the whole of the growth, and at the same time is able to estimate by touch (for the tip of the finger is left exposed) what is being done. Mr. Baber in the same way uses his own fingernail.¹

Adenoid vegetations.

¹ For further information on this subject and its treatment, the reader should consult Meyer, 'Med.-Chir. Trans.' vol. liii. p. 191; Baber, 'Brit. Med. Journ.' Aug. 5, 1882; Butlin, 'St. Barth. Hosp. Reps.' 1885, p. 158; and Dalby, 'Lancet,' Oct 2, 1886, p. 618.

Ozæna.

One of the most terrible, as it is also one of the commonest, of the maladies which affect the nose is ozæna, or fœtid discharge from the nostrils. This occurs from many causes, of which syphilis and struma are the chief, but frequently also from no definite exciting cause, as far as our investigation enables us to determine. The mucous membrane becomes inflamed, possibly more or less ulcerated, and covered with crusts of inspissated discharge. There is also a horrible odour, not easy to describe, though when once experienced impossible to forget; ¹ the discharge seems to disappear down the pharynx; at least none is perceptible externally in most cases. True ozæna often lasts for years without any further changes, but the syphilitic variety will spread to the bones and cartilages, external openings will form, and the nose will be destroyed.

The victims of ozæna are usually young children, and their infirmity secludes them from the society of their playmates and interferes with their education, as well as rendering them miserable by the persistent odour.

The first thing in the management of this disgusting complaint is to ascertain its cause. I have already dwelt on the importance of making sure of the absence of foreign substances or nasal concretions. I have brought many a case of so-called ozæna to an end by removing a foreign body. The cure of the syphilitic ozæna must be undertaken by antisyphilitic measures, and by the application of mercurial vapours and lotions. It is a phenomenon generally of a late stage of syphilis or of the congenital disease. When it has spread to the bones abscesses must be opened and the general health attended to; but the shape of the features will hardly be preserved.

Thudichum's nasal douche

In strumous ozæna the use of cod-liver oil with arsenic, or of iodide of iron, is generally indicated, and in this and the idiopathic form the use of the nasal douche, as explained by Dr. Thudichum, ² is of the greatest importance. This method of applying solutions to the nose rests on a fact first noticed by E. H. Webber of Leipzig, that when the patient inspires deeply, and only through the mouth, the soft palate is so drawn against the posterior wall of the pharynx that the nose and respiratory pharynx may be filled with fluid, which will run from the nostril into which it is injected over the upper surface of the soft palate and out of the other nostril without running down into the mouth or œsophagus. The apparatus necessary is a receptacle for the fluid, which must be raised over the patient's head to a sufficient height to ensure the requisite force of stream, so as to loosen the crusts from the membrane, an indiarubber tube proceeding out of this receptacle, and a nozzle which will fill the nostril completely, so as to prevent any reflux. The patient is then to sit with his mouth open, breathing exclusively through the mouth, and abstaining from any movement of deglutition. ³ A little practice soon enables him to pass the fluid through the nose without letting any run into his mouth, and till he has acquired the knack it is well only to use lukewarm salt-and-water. The constant stream detaches the crusts, and it can easily be increased or diminished in force by raising or lowering the receptacle, or by suddenly stopping and opening the tube. The detachment of the crusts

¹ The French call it 'punaisie,' from its resemblance to the smell of a bug.

² 'Lancet,' Nov. 26 and Dec. 3, 1864.

³ Special apparatus are sold for the purpose, but when these are not at hand a perfectly serviceable one can be extemporised with a common ewer and a syphon provided with a tube. The addition of a stopcock near the nozzle is convenient; but if there is none the patient can easily stop the stream when necessary by pressure with the thumb and finger.

is also much facilitated by reversing the stream, the nozzle being changed from one nostril to the other. The lotions recommended by Dr. Thudichum are—for mere ablution, warm salt-and-water, which irritates the nose less than plain water; for deodorising purposes, Condyl's solution diluted, or carbolic acid lotion, 1 in 40; solutions of the alkaline phosphates (phosphate of soda, or phosphate of ammonia and soda) for dissolving the crusts and promoting their removal; as astringents, alum, sulphate of copper or of zinc; and as alteratives and specifics, nitrate of silver, bichloride of mercury, or a solution of chloride of calcium, with suboxide or oxide of mercury suspended in it, made by mixing the ordinary black or yellow wash with common salt. In obstinate cases these applications must be often varied. Mr. Pugin Thornton¹ has spoken highly of the following lotion, used cold in the form of spray by means of a handball apparatus:—Sodæ carb., sodæ bibor., āā ʒij.; liq. sod. chlor. ʒss.—ʒij.; glycerini ʒj.; aq. ad ʒviij.

Lately an operation has been introduced in practice by Dr. Rouge of Lausanne² for the cure of ozæna, based upon the hypothesis that in many of these cases the bones are diseased—whether primarily, or in consequence of the ulceration of the soft parts which cover them—and that if the diseased bone be removed the ozæna will be cured, whilst without such removal the disease will go on for a time which is practically unlimited. And there can be no doubt that this is true of many cases of ozæna, though it is extremely difficult to diagnose the cases to which Rouge's operation is appropriate—nor is the operation itself by any means an easy one, or free from danger. The operation is, of course, performed under complete anæsthesia, and as the bleeding is generally very free, a good deal of trouble may be caused by the passage of blood into the air-tubes—in fact, in a patient under my care serious danger was caused by the inhalation of blood into the lungs. The whole framework of the nose is to be lifted up by an incision made inside the mouth through the juncture of the nose and lip—the septum nasi and the lateral cartilages being divided with strong scissors till the bony opening is completely exposed. This being done, the nasal cavity can be explored on either side very thoroughly, any bone found loose removed, and the ulcerated bone and the unhealthy mucous membrane scraped away, as far as may be judged prudent; for it must be recollected that death has been caused in operations of this kind by too great violence applied near the base of the skull. When the parts are replaced and fixed in position by strapping, they will adhere, and no trace of the operation will remain. The same operation is also applicable to cases of obstinately-recurring polypus. The difficulty experienced in cases of ozæna is, as a general rule, to know when, or in what cases, to recommend the operation. There are, no doubt, some cases (usually, I think, traumatic) in which dead bone is loose and produces a horrible fœtor; but in such cases the loose bone can generally be got away without incision. In many cases of ozæna exposed bone can be felt, but it is often only a portion of a large ulcerated surface, and the surgeon is disappointed in his attempt to remove it. In other cases, though the disease may have existed for a long time, no evidence of diseased bone can be found, and most likely there is none, or, if there be, it is only a small part of the disease. Nor can the surgeon honestly represent to the patients or their friends that the operation is free from grave danger. Still the disease is so disgusting to others and so distressing to the patient that I consider the at-

Rouge's
operation
for ozæna.

¹ 'Brit. Med. Journ.' March 27, 1880.

² 'Nouvelle Méthode pour le Traitement chirurgical de l'Ozène,' 1873.

tempt at radical cure justifiable in cases which seem otherwise incurable, if after fair explanation the patient wishes to have it made. My own experience of the operation is limited to two cases, one of ozæna, and one of polypus, in neither of which was I satisfied with the result at the time. Yet the patient has in neither case consulted me again, though in both they promised to do so if the disease was not cured. I would refer also to a paper by Mr. Warrington Haward on Ozæna in the eighth volume of the St. George's Hospital Reports, or to the same author in 'Syst. of Surg.' 3rd ed. vol. ii. p. 643. Mr. Haward remarks that in many cases sufficient access to the nasal cavity will be obtained, without the dangers of Rouge's operation, by forcibly displacing the septum to the opposite side, under anæsthesia, and pushing it back into its place when the exploration is completed.

Affections
of the
septum.
Blood
tumours.

Deviations of the septum have been spoken of above. The septum is also liable to the formation of blood-tumours from injury, which affect both sides of the septum, and sometimes proceed to such an extent as to obstruct respiration and render an incision necessary. But this is rare. The affection is, it seems, usually accompanied by fracture of the septum. In most cases it will subside under the local application of cold.

Abscess.

Abscess of the septum is sometimes the result of injury, but it occurs also spontaneously, and sometimes in a chronic form, going on to perforation, which may produce a disagreeable whistling in speaking, or deep breathing. The diagnosis of the complaint is sometimes a little difficult at first, the swelling being confounded either with polypus or chronic thickening of the Schneiderian membrane; but an attentive examination will show the difference in the seat of the swelling, and an exploratory puncture will clear up the case. Free and early incision is always desirable, and Mr. Durham says that benefit may be derived by injection of a weak solution of nitrate of silver or of some detergent lotion into the nostril. If the septum is perforated by a small opening and the unpleasant whistling sound distresses the patient, his condition may sometimes be relieved by making the opening larger.

Enchondroma.

The septum is not unfrequently the seat of cartilaginous tumours, which sometimes also spread to the other cartilages. Those I have seen have been of small size, and have grown into both nostrils, and it has been sufficient to remove such portions as could be got at from the nostril without any external incision. But larger tumours might require the free division of the nostril in order to allow of their complete extirpation.

Nasal
polypus.

Nasal polypus is a very frequent, and in some of its forms (though these are fortunately the less common ones) a very formidable disease. The division generally made of nasal polypi, and that which best corresponds to what is seen in practice, is into three chief forms—gelatinous or mucous, fibrous, and malignant.

The first are by far the most common. They originate generally from the mucous membrane which covers one or other of the turbinated bones—more frequently, as I believe, from the middle, though opinions differ as to what is commonly their precise attachment; but all authorities agree that they rarely if ever spring from the septum or from the roof of the nose.¹ They

¹ 'Their most common seat,' says Mr. Spencer Watson, 'is the lower part of the middle turbinated bone, but they may in fact spring from any part of the nasal fossæ or their sinuses, though there is no recorded instance of their growing from the septum nasi, except one specimen in the museum of St. Thomas's Hospital.' Mr. Watson figures a polypus growing from the frontal sinus, and one springing from the orifice of the antrum.

are often multiple. Their structure consists of a fine fibrous tissue covered externally by the mucous membrane with its ciliated epithelium, whilst at other times adenoid structure is found in them as though from a hypertrophy of the glands of the part. The microscopic structure is generally of the myxomatous character (see p. 358). Other polypi approach more to the character of fibrous or fibrocellular tumours, and in some, cysts are found developed. They produce well-defined symptoms by which the nature of the disease may often be suspected before physical examination converts the suspicion into certainty. These symptoms are a mixture of catarrh and obstruction. The patient seems to be constantly catching cold and sneezing; but besides this he notices that his breathing is obstructed, he cannot sleep but with his mouth open, his voice is affected and acquires a nasal tone, he observes that he cannot breathe, or can hardly breathe, through the nostril. The obstruction as well as the catarrh are noticed to increase in damp weather, when the tumour increases in bulk. As the disease advances it produces flattening and expansion of the nose, and interferes with the passage of the tears down the nasal duct.

The proper course to pursue is to remove the polypus; but it frequently presents again, either in consequence of renewed growth from the base, or



FIG. 297. The common polypus of the nose.—After Liston.

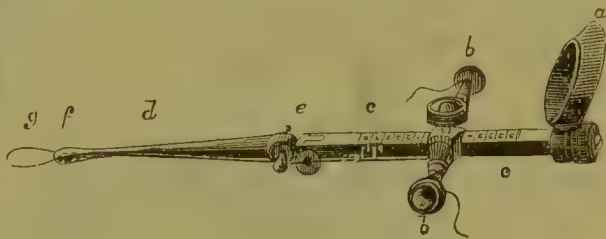


FIG. 298. Hilton's nasal polypus snare. *a*, ring for the surgeon's thumb; *b b*, movable cross-piece, pushed backwards and forwards by the fore and middle fingers, so as to advance and retire the loop *g*, which in practice is far larger than is here shown. The stem *c* is hollow for the ends of the wire to run in. They are wound round the cross-piece. *e* is a hinge-joint, by means of which the stalk *d* which is in the nose can be placed at the requisite angle with the stem *c*. Its bulbous end, *f*, is perforated by two holes to convey the wire. The end of the wire is pushed round the polypus either with the fingers or a kind of fork.

from there having been really several polypi, of which one or more have been left behind unperceived. The best security against this recurrence is when the portion of bone from the covering of which the polypi grow has been designedly or accidentally removed along with them. Rouge's operation enables the surgeon to remove the whole of the polypi, and even to scrape away their bases from the bone; and this becomes still more easy when the growth of the tumours has distended the nostril.

Polypi may be removed either with the snare or the forceps. The snare is a loop of wire the ends of which are passed into the tube of a double cannula, either before or after the loop has been conveyed around the polypus, and pushed up as near its base as possible. The cannula has a handle attached to it by means of which the wire is drawn through the base of the polypus gradually or rapidly, as the surgeon thinks best. Some operators even use the galvanic *écraseur* for this purpose, but, as far as I can see, without any sufficient cause. The main point is to get up to the root of the polypus, and I confess that it appears to me that this end is better attained by means of the common forceps. If the nostril is wide the tumour may be gently drawn down with one pair of forceps, while another is pushed firmly up

to its attachment and the mass twisted off. Then, after bleeding has somewhat ceased, or next day, the nostril is to be carefully examined to see whether there are any others. The chief error made in the diagnosis of polypus is to confound the chronic thickening of the mucous membrane, which often occurs in strumous young persons, with polypus. When the end of the inferior turbinated bone is covered with this thick pulpy mass it looks at first sight exactly like a polypus; but careful examination can hardly fail to detect the nature of the case if the surgeon is alive to the possibility of the error, since there is in this case no stalked pendulous soft tumour as in the other, and the neighbouring mucous membrane will be found similarly, though perhaps less distinctly, affected. The success of astringents as applied for the cure of so-called polypus is, I suspect, more real in cases of this sort than in true polypoid growths. At the same time Mr. Bryant has spoken highly¹ of the



FIG. 299. A fibrous naso-pharyngeal polypus, which had long caused epistaxis, so that the patient was exhausted by daily loss of blood. It was removed from the base of the skull by partial resection of the upper jaw in the year 1866. The portion of bone removed is figured with the tumour, and is seen to comprise the whole of the upper jaw, with the exception of its orbital portion. The tumour consists of two parts—*a*, that which projected into the nostril, and, *c*, that which hung down into the pharynx. Between these is a constricted part, *b*, where the mass was implanted into the base of the skull just behind the posterior nares. On microscopical examination it consisted almost entirely of fibrous tissue with some cellular elements. The patient remained well for some years, but gradually the bleeding recurred, and the tumour was found to be growing again. It was again removed eight years after the original operation, and was found to have the same structure. The patient again rapidly recovered his health and was quite free from recurrence in the year 1887.—See 'Clin. Soc. Trans.' vol. viii. p. 68.

success sometimes obtained by the insufflation of the powder of tannin (about ten grains blown into the nose with a tube) in some cases even of large polypi, though he owns that it is a very uncertain remedy. Mr. Reginald Harrison has had some success by merely incising or freely puncturing the polypus and then injecting a solution of carbolic acid and glycerine.²

Cases have been known in which the deviation of the septum has been mistaken for polypus, but this is mere carelessness. Tumours of the septum are distinguished from ordinary polypus by their position.

Fibrous
polypus.

Fibrous polypi are far more formidable tumours than the gelatinous. They spring generally from the roof of the nasal fossæ or from the base of the skull behind the posterior nares,³ and they grow into the nasal cavity, displac-

¹ 'Lancet,' Feb. 1867.

² 'Brit. Med. Journ.' Nov. 15, 1879.

³ I ought to mention that these tumours, besides their primary attachment, are some-

ing the bones of the nose (causing the peculiar appearance called 'frog's face'), or into the nose and pharynx at the same time (naso-pharyngeal polypus). These polypi are usually accompanied by considerable bleeding, and I have known this bleeding allowed to go on so long (in consequence of its cause having been overlooked) that it threatened at last to prove fatal. Yet the tumours themselves are not so vascular as to occasion any formidable hæmorrhage on removal, though they get congested and their depending surface bleeds freely on being touched. Their continued growth causes various symptoms due to pressure on the neighbouring organs (deafness, epiphora, &c.), and they may even absorb the base of the skull and cause pressure on the brain. The extirpation, therefore, of the tumour is urgently indicated, and there are many ways in which this may be done. In some cases it may be possible to reach the base of the tumour either from the nostril (if this is much dilated)¹ or, under anæsthesia, from the pharynx, the mouth being kept wide open by means of Mason's Gag, and thus a wire can be conveyed round the base of the tumour, which can be connected either with the galvanic or common *écraseur*, or with the ordinary snare, and then the mass may be removed. In some cases it is perfectly easy to twist off the tumour from the mouth with a pair of curved forceps. But such cases are the minority. In most instances of fibrous polypus a way must be made by surgical operation through the tissues of the face to the base of the tumour, and this by one of three operations: (1) from below, through the hard and soft palate; (2) from above, through the nose; and (3) from the front, through the upper jaw.

1. The first method is known as Nélaton's. It is little practised in this country, and seems much inferior to the third in cases where the nostrils are not much dilated, and to the second in those where they are. The soft and hard palates having been divided with a knife, and as much of the palate processes of bone as may be necessary having been removed with the bone-forceps, the tumour is to be exposed and removed, and the palate then sewn up.

2. When the nose is much dilated ample room may be obtained by an incision on one side of the middle line from the roof of the nose to the nostril. The nasal bone is to be divided in the course of the incision, the soft parts turned aside, and the tumour exposed and removed. Then the wound is accurately adjusted by sutures, and, unless any accidental complication interferes with union, only a trifling mark will be left.

3. An incision is to be made along the lower margin of the orbit, and along the side of the nose, curving round the nostril to the middle line of the lip, and thence down to its free edge, and the cheek turned outwards. Then the hard palate is to be sawn through, and next the zygoma, and then the saw or bone-nippers must be carried through the nasal process below the orbit, and in this way the whole of the alveolar portion and body of the jaw are removed, when the operator will have free access to the base of the skull. After the tumour has been taken away the bone from which it grows is to be freely rasped, and the actual or potential cautery applied to the place of implantation.

Again, the whole upper jaw may be removed, or Langenbeck's method adopted, by which the soft parts are incised down to the bone externally and

times implanted, as it were, into other parts of the nasal mucous membrane, where probably ulceration has occurred both on the surface of the polypus and of the Schneiderian membrane, and the ulcerated surfaces have coalesced.

¹ When the nostril is much dilated the two forefingers may be used from the back and front at once to detach the tumour, the patient being completely anæsthetised.

internally, as in the old method of removing the jaw; then the attachments of the bone are sawn through in the same lines, the palatal attachments divided, and the jaw with its coverings turned up over the eye, and, after the removal of the tumour, brought down again and fixed in its place by deep sutures, the soft palate being left undivided.

Malignant
polypus.

Sometimes cancer grows in the form of a polypus from the mucous membrane of the nose.¹ Such tumours are usually of very rapid growth; they speedily dilate the side of the nose, and cause much hæmorrhage. They rapidly fungate out of the nostril, and are very apt to infiltrate the skin of the face. The patient is usually somewhat advanced in years, and the general health is much impaired. The diagnosis is not difficult, from the rapid growth of the tumour, the change of shape in the features, and the great cachexia which is commonly found.

The removal of the tumour is urgently indicated, for which purpose any of the plans previously proposed in the case of naso-pharyngeal polypus may be selected according to the presumed attachments of the tumour, which, however, it is by no means easy to ascertain. Careful examination should be made both anteriorly and from the posterior nares with the finger, and if possible by rhinoscopy, before such an operation is attempted; and the surgeon ought to have the actual cautery and all other necessary hæmostatics ready, in case he finds the tumour implanted by a broad base of vascular tissue. After all, a speedy recurrence is to be feared.

¹ I had once under treatment a case in which the tumour was of the melanotic variety (spindle-celled sarcoma, with black pigment in the cells). It grew from the outer side of the nasal cavity, and was easily removed by laying open the nostril. The patient, a man of advanced age, recovered from the operation, but died from some affection of old age not long afterwards. Similar melanotic deposits were found on the lining membrane of the antrum.

CHAPTER XXXI.

SURGICAL DISEASES OF THE DIGESTIVE TRACT.

DISEASES OF THE TONGUE.

TONGUE-TIE is a tolerably common deformity, which, in its higher degree, will prevent the child from sucking, and may hereafter interfere to some extent with articulation; though this is more spoken of than really proved. However, if the deformity be at all pronounced, it is well to perform the little operation which will release the tongue and restore its motion. If performed carefully this slight incision is free from danger of any kind. All that is necessary is to avoid dividing the ranine artery as it passes along the frænum linguæ. The tongue is pushed up and the artery shielded from harm either by the surgeon's fingers or by a slit in the flat end of the director, which used always to be made in this shape for the purpose. The incision or little nick need only extend through the semi-transparent edge of the constricting tissue, and the tongue be forcibly pressed upwards to the roof of the mouth, by which manœuvre the rest of it will be torn. I have performed this little operation a very great number of times—chiefly for the satisfaction of the parent—though in only a small proportion of them could I persuade myself that it was really indispensable. I have, however, seen cases in which the child undoubtedly could not take the breast till the tongue was released. Tongue-tie.

The tongue is occasionally found to be much enlarged and hypertrophied and to prolapse from the mouth. This condition is termed *macroglossia*, and is usually congenital, but may be acquired. In its pathology it closely resembles elephantiasis, consisting in an increase of the connective tissue of the tongue, with dilated lymphatic vessels and spaces filled with lymphoid tissue. The tongue is seen to be greatly enlarged and to loll out of the mouth, so that the child cannot close his jaws or talk intelligibly. It presents a congested, purplish appearance and is dry on the surface. There is constant dribbling of saliva. The prolapsed tongue, pressing on the teeth, often displaces them, and occasionally causes deformity of the jaw, pushing the alveolar process forwards. The only treatment which appears to be of any use is to remove a V-shaped piece from the prolapsed portion and to unite the side-flaps which have thus been formed by sutures in the middle line. The operation is usually attended with great success.¹ Macro-glossia.

The tongue may also become hypertrophied as the result of inflammation, generally caused by syphilis; or, on the other hand, it may undergo atrophy from nerve lesion. This condition is generally, therefore, unilateral, whilst the other side of the organ frequently becomes enlarged.

Acute inflammation of the tongue is occasionally met with, sometimes arising without apparent cause, sometimes occurring after fever, and at other times attributed to cold, or injury, or the introduction of some septic matter from the bite of an insect or some such similar cause. I have seen it occur Acute glossitis.

¹ The leading cases of this disease will be found reported by Dr. Humphry, Mr. Hodgson, and Mr. Teale in the 'Med.-Chir. Trans.' vol. xxxvi.

also in the later stages of granular kidney. It may also occur, though in a modified form, from mercurial or iodine poisoning. The advent of the disease is generally sudden, and is attended with great swelling. The tongue protrudes out of the mouth and projects beyond the teeth. It is red, smooth, and very painful. In some cases the swelling is so great that the base of the tongue fills the pharynx and threatens suffocation; possibly, however, this condition may arise from an extension of the inflammation backwards to the glosso-epiglottic folds and epiglottis. Under treatment the swelling generally subsides rapidly, but sometimes the inflammation may go on to sloughing, and then death is likely to occur from septic pneumonia. The treatment consists in making a free longitudinal incision deeply into the substance of the tongue on either side of the median raphé. This gives immediate relief and the swelling rapidly subsides. In incising the tongue it is useful to remember Mr. Holmes Coote's caution, viz. that the swelling is sometimes really more in the lower than the upper portion of the tongue, and that the lingual arteries have thereby been pushed up so that they may even appear on the dorsal surface of the organ. A little preliminary examination before the incisions are made will point out where they can be placed with safety. At the same time astringent gargles (alum, tannin, or iron) and warm fomentations should be assiduously used, and the patient's strength supported as may be necessary. Less acute cases, where the symptoms are less severe, require no incisions. In other respects they are to be treated in the same way.

Abscess in
the tongue.

Inflammation of the tongue may end in deep-seated abscess. Or occasionally chronic abscess may occur without assignable cause and without any of the earlier signs of inflammation. It forms a deep-seated round elastic tumour, situated in the thickness of the tongue, and has before now been mistaken for cancer, and the tongue removed. The shape and feeling of the tumour, the history of the case, and the resemblance to those chronic abscesses with which the surgeon is familiar in the female breast ought at any rate to awaken suspicion, when an exploratory puncture will clear up the diagnosis, and a small incision will constitute all the treatment required.

Chronic
superficial
glossitis.

Inflammation of the superficial structures of the tongue of a chronic character is an affection which has attracted considerable attention of late years, but is one which is involved in a certain amount of obscurity. It presents its effects in many different ways at different stages of the disease, and this has given rise to its being called by many different names,—leucoplakia; psoriasis; ichthyosis—which has not tended to diminish the confusion. It is in the initial stage a chronic inflammation of the mucous membrane of the tongue, and probably in all cases commences with a hyperæmia of the mucous membrane, and especially of its papillæ, during which the tongue is red, somewhat swollen, and glazed. This condition does not affect in the first instance the whole area of the dorsum of the tongue, but occurs in patches, and is soon followed by an overgrowth of epithelium, which becomes heaped up on the inflamed patches and forms whitish or greyish opaque plaques, which are not always confined to the dorsum of the tongue, but occur also, sometimes, on the mucous membrane on its under-surface, and on that lining the interior of the cheeks. To this condition the name *leucoplakia* is given, and by some it is considered as a distinct disease, and it is by them considered doubtful whether it is preceded by the hyperæmic stage. After the patches have formed, and perhaps to a certain extent coalesced, they become smooth from atrophy of the papillæ beneath, and the tongue becomes covered more or less completely with dead-white patches, which are often deeply fissured

or furrowed, and to which, from their resemblance to psoriasis palmaris, the term *psoriasis linguae* has been given. Its analogy with psoriasis of the skin is uncertain, but Mr. Barker,¹ in 110 cases which he has collected, found that it was associated with psoriasis or eczema in six and with syphilitic psoriasis in two. Occasionally the thickening of the epithelium is so excessive that the tongue becomes hard and stiff, covered with thick scaly masses on its surface, which often present numerous cracks. To this condition, to which attention was first drawn by Mr. Hulke, the term *ichthyosis* is given. The conditions of leucoplakia, psoriasis, and ichthyosis are to be regarded, therefore, as different stages or different modifications of the same disease, and may all be observed in the same case at different periods of its progress.

In the early stage, as a rule, the patient complains of little pain; perhaps some discomfort in eating, especially when taking any hot liquid or highly spiced food, and frequently so lightly regards his condition that he does not seek advice, and hence the disease at its commencement is overlooked. If, however, the tongue is examined during this stage, it will be found to present oval or oblong raw patches of a deep red colour; and if the organ is carefully dried with a towel, these patches will be found to be smooth and glossy. Later on the various changes in the condition of the tongue, above described, will become apparent.

The disease is exceedingly chronic in its character, and may last for years, passing through its various changes very gradually; but at the same time it is very obstinate and intractable and difficult to cure. It does not, as a rule, cause much suffering, and possibly, therefore, the patient is less careful in carrying out any prescribed course of treatment than he would be if the disease entailed more suffering. Sometimes ulceration of one or more of the patches takes place, and then the amount of pain complained of is considerably greater. The disease derives its chief clinical importance from the fact that it is only too frequently the forerunner of epithelioma. Of the 110 cases collected by Barker, 43 ended in epithelioma. Therefore cases should be zealously watched, and upon the earliest indication of this formidable complication appearing, active measures should be adopted.

As regards the etiology of the disease very little is at present known. Formerly every case was regarded as syphilitic; and there is still good reason to believe that this disease is at all events an important factor in the production of chronic superficial glossitis in a considerable percentage of cases. Smoking is admitted by all to be a potent cause in the production of the disease, and habitual intemperance, especially the custom of drinking spirits, is usually regarded as also conducing to it. The treatment is unsatisfactory. The main indication is to remove the cause and carefully diet the patient. A milk diet is by some believed to be best adapted for these cases. At all events the food should be plain and nutritious; all highly spiced meat, hashes, stews, curries, &c., should be avoided, with pepper, mustard, and hot sauces. Stimulants should be interdicted and smoking forbidden. Gargles of bicarbonate of potash (Barker) or chlorate of potash are to be constantly used. Bryant recommends the internal administration of arsenic, which he says he has certainly found to do good in these cases.

Amongst other conditions of the mucous membrane of the tongue is the *annulus migrans*, as Mr. Barker (who first described it) calls it—‘a small round spot of a whitish or greyish colour, which rapidly develops into a more or less complete circle or crescent,’ travelling over the dorsum, and sometimes affect-

Annulus
migrans.

¹ ‘System of Surgery,’ 3rd ed. vol. ii. Article on ‘Diseases of the Tongue.’

ing the under-surface. It leaves the surface smooth and livid, is not followed by ulceration, and causes no symptom beyond some smarting in the use of particular kinds of food, and sometimes itching and salivation. No treatment has hitherto been found efficacious, but, as far as is known, it leads to no ill-consequences.

Ulceration
of the
tongue.

The forms of ulceration to which the tongue is liable are the irritable, the dyspeptic, the tubercular, and the syphilitic. (1) *Irritable* ulcers are excited by the irritation of rough teeth; they are very painful, and afford considerable impediment to eating, and are often associated with or allied to the dyspeptic ulcer. The treatment consists in extracting or filing down the offending tooth. (2) The *dyspeptic* ulcers are generally multiple. They present the appearance of irritable-looking sores, with a reddened surface, raised edges, but without any evidence of solid deposit around. They are very painful, especially during mastication, and the haggard aspect of the patient produced by the pain and want of food may cause them to be mistaken for cancer. The treatment must consist in correcting the state of the digestive organs and attending to the local condition of the ulcers. Often the local application of solid nitrate of silver relieves the pain considerably. (3) *Tubercular* ulceration of the tongue is a rare disease, to which attention has lately been directed. It usually occurs in the later stages of pulmonary phthisis, and consists in the first instance in the deposit of an isolated mass of tubercle, generally on the under surface or sides of the tip of the tongue. This rapidly caseates and suppurates, and similar deposits take place around, and, coalescing, form an irregular ulcer, which is extremely painful. If the patient is in a condition to bear the slight operation, the base of the sore should be thoroughly scraped with a Volkmann's spoon and iodoform applied. Otherwise, the only thing which can be done is to relieve the pain, for which the local application of morphia and compound tragacanth powder seems best suited. (4) *Syphilitic* ulceration of the tongue is only one of various forms of syphilitic affections of this organ, which it is more convenient to consider altogether.

Mr. Fairlie Clarke¹ divides the syphilitic affections of the tongue into four classes: (1) mucous tubercles or vegetations; (2) superficial ulceration; (3) gummatous tumours and deep ulcerations; (4) morbid conditions of the mucous membrane. To these ought to be added primary sores—indurated chancres of the tongue, though they are very rare and present nothing peculiar from indurated chancres in other situations. The first, the *mucous tubercle*, is an early secondary symptom which affects both the papillæ and epithelium, the tubercles in which the epithelium is chiefly implicated being broad, flat, and whitish; the others small, prominent, and florid. They have much resemblance to the mucous tubercles so often seen on other parts, and are distinguished from the papillary elevations of cancer by the absence of any hardening at the base. *Superficial ulceration* is also usually a secondary affection. It spreads from similar ulcerations on the sides of the mouth and cheeks, forming superficial and very painful fissures, which in their healing leave milk-white scars; and if these are very numerous and the epithelium gets overgrown around them, the condition named syphilitic ichthyosis is present.² In other cases the superficial cracks spread out into large circular

¹ 'Diseases of the Tongue,' chap. viii.

² Mr. Barker points out that it is necessary to distinguish between the true ichthyosis, which, he says, is usually, if not always, independent of syphilis, and the syphilitic condition which is commonly confounded with it. The latter, he says, is easily cured by anti-syphilitic treatment, the former only aggravated by it.

or oval sores. The *gummatous* tumours which form in the tongue are seen either at its edge or, more frequently, close to the septum; and when they soften they leave the deep tertiary ulcer, or sometimes deep fissures, which may implicate the whole organ and distort it. In other cases they become absorbed, and then may be followed by some distortion of the organ from loss of substance. The *syphilitic affections of the mucous membrane* generally resemble psoriasis, consisting of a heaping up of epithelium of a dead-white colour over a limited area; in other cases the whole of the dorsum may be attacked with superficial inflammation (syphilitic glossitis), but this is often the result, not of syphilis only, but also partly of the abuse of mercury; and, according to Mr. Clarke, iodide of potassium when it does not agree with the patient may produce a similar affection. In most of these syphilitic conditions of the tongue, treatment by mercury is necessary. The exhibition of the drug requires great care, and it should not be given either rapidly or in large quantities. The calomel fumigation is, I doubt not, by far the best form, and is very easily managed by adapting a mouthpiece to the vaporising-machine and inhaling the vapour. Five grains of calomel every night is the quantity usually prescribed, or the ulcer may be dusted with grey powder (gr. v.) daily. In some cases sarsaparilla and iodide of potassium may be given when the surgeon dares not risk the debilitating effect of mercury, which, however, is very trifling when the method of fumigation is employed.

Occasionally innocent tumours are met with in the tongue, but in the majority of cases tumours of the tongue are of a cancerous nature. Amongst the innocent growths are occasionally found papillomata—small warty growths, which merely require removal. They must always, however, be regarded with a certain degree of caution, since epithelioma may originate in this way. Fibromata and lipomata are sometimes found embedded in the substance of the tongue, and may in some cases require removal. Nævi are also found, but very rarely, on the tongue. They may be treated by electrolysis, the actual cautery, or some of the potential cauteries, or even by excision; or the ligature, should that be necessary, which, however, is seldom the case, since these nævi more commonly prove quite innocuous. Another congenital affection is a fibroid tumour which sometimes grows from, or in, the tongue, and which may be quiescent at first and then increase at a later period of life and require removal.¹

Tumours of the tongue.

The variety of malignant disease which usually affects the tongue is squamous epithelioma—a disease which is much more common in men than in women, and almost invariably commences on the edge of the tongue, usually of the middle third. It may begin as a wart or tubercle, or in a crack or fissure, often originating in an abrasion produced by a jagged tooth, or sometimes as a sequel of glossitis. From whatever cause arising, it soon develops into an ulcer with indurated base. At first the pain is slight, but soon becomes severe, and especially great upon any movement of the tongue in deglutition or speaking. As the ulcer increases the pain extends to all the parts supplied with sensation by the fifth cranial nerve, radiating over the side of the head and face. The parts around become infiltrated, and the disease extends to the floor of the mouth, fixing the tongue and materially interfering with speech and deglutition; so that the voice is altered, there is constant dribbling of saliva, and swallowing is only performed with great pain and difficulty. If the tongue is now examined there will be found to be an

Cancer of the tongue.

¹ See Mason, 'Path. Soc. Trans.' vol. xv. p. 216; and also Hutchinson, 'Med.-Chir. Trans.' vol. lxviii. p. 311.

excavated sore with everted and ragged edges and a sloughy surface. The sore is surrounded by induration, which spreads for an indefinite distance into the substance of the tongue, and possibly implicates the arches of the palate and the floor of the mouth. There is great fœtor of the breath, and foul discharge. The lymphatic glands below the jaw are early affected. The patient rapidly loses flesh, and, from the pain, inability to swallow, and loss of appetite from the foulness of the discharge, sinks and dies of exhaustion: the average duration of life from the commencement of the disease being about two years.

The diagnosis, though it may often be difficult or impossible at first, becomes only too easy as the disease progresses, and in the later stages there is no difficulty in coming to a correct opinion as to the nature of the disease. It is, however, of the most vital importance that a diagnosis should be come to early if any material benefit is to be hoped for from operative treatment; and then it is by no means easy in every case to distinguish it from tertiary syphilitic disease of the tongue. The main points on which the diagnosis must be based are as follows. In the cancerous tongue the patient is almost always over forty years of age, whereas in a considerable percentage of cases of syphilitic ulcer the patient is under forty; so that the occurrence of an ulcer of the tongue in a patient *under* forty would be strong presumptive evidence that it was syphilitic, whilst occurring in one over forty it would be rather in favour of its being cancerous. The situation of the ulcer would be of some importance: if situated at the margin of the tongue, it would point to cancerous disease; if in the centre, to syphilitic. The appearance of the sore would be a further indication: in the epitheliomatous ulcer, the surface of the sore is sloughy, with raised everted edges; in the syphilitic ulcer, the sore is deeply excavated, with undermined edges, or else it is covered with a washleather slough. The induration in cancer is widespread, and gradually fades away into surrounding tissues; in syphilis, it is not nearly so great, and is more limited and circumscribed. In cancerous disease, the floor of the mouth is frequently involved and the tongue fixed; this is not so in the syphilitic ulcer. The pain, difficulty in swallowing, and impairment of speech are very much greater in the one disease than the other. The glands may be enlarged in either, but are more frequently so in the cancerous ulcer, since the syphilitic is usually a tertiary symptom; and in syphilitic ulcers, if any glands are enlarged in the neck they are not usually the submaxillary, which are in direct connection with the ulcer, but the posterior chain of cervical glands beneath the trapezius. In addition to these differences, the presence in most cases of other syphilitic symptoms in the one form of the disease and their absence in the other may assist the surgeon to come to a correct opinion. Should any doubt still remain it is right to subject the patient to a course of antisyphilitic treatment, when the amelioration of the patient's condition in the one instance and the progress of the disease in the other will at once settle the question.

Treatment
of cancer
of tongue.

If the cancerous nature of the affection admits of no doubt, the only question is whether a surgical operation is to be recommended, and if so, of what nature. If the glands, or the floor of the mouth, or the palate be implicated, surgical operations should be declined. But if the whole disease can be cleanly removed the patient will, no doubt, derive much temporary benefit from the operation, though the disease will in all probability return in no long time.

When only a small portion of the tongue requires removal, this is best

effected by means of the knife or scissors. A clamp with curved blades being fixed around the part to be removed so as to control the vessels, the portion affected with cancer is to be completely cut away. The bloodless condition of the parts cut through enables the surgeon to judge much more certainly whether those parts are healthy or not. When he is satisfied that all is as it should be, the arteries are to be tied and the clamp cautiously relaxed. Some surgeons, either instead of or in addition to the use of the ligature to

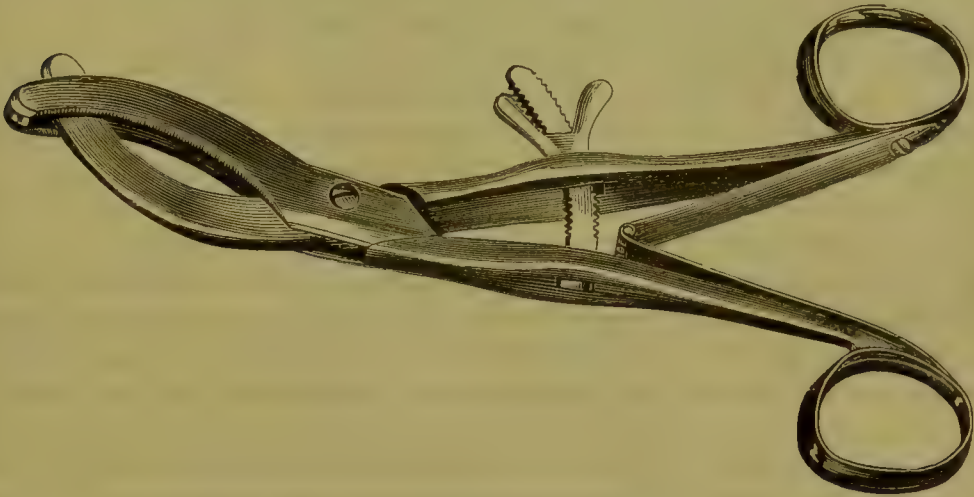


FIG. 300. Mr. Henry Lee's clamp. The curved shape of the blades causes this clamp to make uniform pressure on all the tissue which it embraces.

the large vessels, use the actual cautery to the cut surface; but this is objectionable if it can be avoided, on account of the sloughing and fœtor which ensues.

When larger portions of the tongue are to be removed, either the ordinary *écraseur* or the galvanic *écraseur*¹ is preferable, as affording more security against secondary hæmorrhage, provided the chain is drawn

Removal
of part of
the tongue.



FIG. 301. Écraseur.

through the tissues very slowly. Hæmorrhage during or after the use of the *écraseur* arises generally from hurry on the surgeon's part.

In all operations on the tongue the surgeon should always have a command on the part left behind by means of a stout ligature passed through it, tied loosely, and held by an assistant, so that on the occurrence of acute hæmorrhage the tongue can be at once pulled out and the bleeding part

¹ The galvanic *écraseur* is a stout wire chain attached to the poles of a galvanic battery. The tissues to be removed are taken up by means of curved needles; the wire is then conveyed around them beneath the needles, drawn tight, and connected with the battery, when it turns white-hot. As it burns its way into the tissues it is slowly wound up by a contrivance inside the machine, and so gradually cuts its way out. In practice it is well to have the battery managed by an electrical mechanician.

exposed ; and the mouth must, of course, be kept open by a gag, the smaller and stronger the better. Hutchinson's gag, here figured, is recommended by Mr. Heath, and is a very convenient one as taking up no room in the mouth.

Removal of
the whole
tongue.

When the whole or the greater part of the tongue is to be removed, it becomes necessary by some preliminary operation to obtain access to the root of the organ, and this is done in one of three ways: 1. A small incision may be made close inside the lower jaw from the mouth to the skin, through which the chain of the *écraseur* can be passed ; and, the tongue being then pulled forcibly out of the mouth, the chain is passed around the base of the organ as near the epiglottis as practicable, and so the whole organ is removed except a stump, which is left attached to the hyoid bone. 2. Sir J. Paget recommends that, in order to render it easier to drag the tongue out, all the muscles which pass from the jaw and hyoid bone to the tongue should be divided on both sides as near the jaw as possible by an incision inside the mouth. When this has been done the tongue can be drawn almost entirely out of the mouth and removed either with the knife or *écraseur*. 3. But the method which gives the freest access to the root of the tongue is, doubtless, the division of the symphysis of the lower jaw. An incision is made in the middle line through the whole lower lip and drawn nearly down to the hyoid bone. Then the jaw is sawn through and the lingual muscles cut away from it close to the bone on either side. The halves of the jaw being held asunder, the tongue is forcibly pulled forwards and to one side by means of a *vulsellum*, and its attachments to the hyoid bone severed on the opposite side, in doing which the lingual artery is cut across, and must be tied at once. The same manœuvre is repeated on the opposite side, in doing which it is desirable to get an assistant to hold the parts around the hyoid bone with a pair of strong claw forceps, in order to prevent the tissues which contain the severed end of the lingual artery from retracting down the neck. Then the second lingual artery and any other bleeding vessels having been tied, the glosso-epiglottic ligaments and the remaining attachments of the tongue are to be severed, and all bleeding vessels commanded. Then the severed halves of the jawbone must be united by means of a silver wire passed through them with a drill, the wound of the lip accurately closed with the harelip suture, and the patient kept under the influence of morphia for some time, and fed if necessary by the rectum.

Mr. Morant Baker recommends removal of the tongue by median division. Having passed a whipcord ligature through the tip of the tongue on either side, he makes an incision through the mucous membrane exactly in the median line of the dorsum, and then with the forefingers of the two hands he splits the tongue into halves. He now with blunt pointed scissors and his forefinger divides the mucous membrane and muscles which connect the tongue to the lower jaw, keeping as close to the bone as possible, until he has got well beyond the level of the posterior edge of the cancer. He then slips a loop of whipcord connected with an *écraseur* over the diseased half and separates it from the rest of the tongue by this means. The other half of the tongue may similarly be dealt with if necessary. This method is now largely employed, and has yielded excellent results.¹

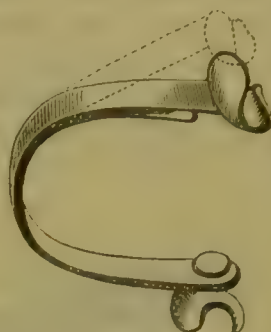


FIG. 302. Hutchinson's gag.

¹ 'Brit. Med. Journ.' vol. ii. Oct. 20, 1883, p. 765.

Mr. Whitehead of Manchester has lately introduced a method of removing the tongue which has been extensively adopted, and has at any rate the merit of simplicity. He thus describes his method in the 'Transactions of the International Medical Congress' (Surgery, p. 259).

The operation is conducted in six stages after the following simple manner :

1. The mouth is opened to the full extent with Mason's or any other suitable gag ; and the duty of attending to this is entrusted to one of the two assistants required.
2. The tongue is drawn out of the mouth by a double ligature passed through its substance an inch from the tip. This ligature is given in charge to the second assistant, with instructions to maintain throughout the operation a steady traction upwards and outwards.
3. The operator commences by dividing all the attachments of the tongue to the jaw and to the pillars of the fauces.
4. The muscles attached to the base of the tongue are then cut across by a series of successive short snips of the scissors, until the entire tongue is separated on the plane of the inferior border of the lower jaw and as far back as the safety of the epiglottis will permit.
5. The lingual or any other arteries requiring torsion are twisted as divided.
6. A single loop of silk is passed by a long needle through the remains of the glosso-epiglottidean fold of mucous membrane, as a means of drawing forwards the floor of the mouth should secondary hæmorrhage take place.

The patient is fed for the first three days by nutritive enemata ; satisfying thirst by occasionally washing out the mouth with a weak iced solution of permanganate of potash. The difficulties and dangers of the operation are few. Hæmorrhage is easily controllable. Mr. Whitehead twice removed the entire tongue without having to secure a single vessel, and more than once had only to twist one lingual artery. Other operators, however, who have used this method have complained of the quantity of foul discharge proceeding from the surface left by the scissors during the healing of the wound. To obviate this Mr. Whitehead advises a varnish, containing the ordinary ingredients of friar's balsam, substituting a saturated solution of iodoform in ether for the rectified spirit. This dries immediately, leaving a firm coating on the stump, which lasts 24 hours and enables the patient to swallow at once.¹

A table of twenty-eight cases, with one death the immediate result of the operation (an old man æt. 69), accompanies the paper. Two other deaths occurred in consequence of the operation, but from remote causes.

Latterly, seeing the great want of permanent success which has attended removal of the tongue for extensive cancer, in consequence of the frequency of recurrence in the glands of the neck,² surgeons have advocated more extensive operations in which the glands shall be removed as well as the tongue. In these operations external incisions are necessary, and a preliminary tracheotomy is highly desirable, indeed is absolutely essential, if the operation is to be at all extensive. A free incision should be made through the cricoid cartilage and upper rings of the trachea, and the windpipe plugged with Trendelenburg's or Semon's tampon-cannula. Then, if the floor of the mouth is diseased, a portion of the lower jaw is to be excised (the cheek having been freely divided), and the diseased tissues, together with the enlarged glands, dealt with as they are exposed. Kocher has introduced an operation in which a flap is turned down in the upper triangle of the neck by a curved incision from the angle of the jaw down to the hyoid bone, and up again to the symphysis, the lingual artery on that side tied, the enlarged glands dis-

¹ 'Lancet,' vol. i. 1885, p. 169.

² See Barker in 'Syst. of Surg,' 3rd ed. vol. ii. p. 604.

sected out, the opposite lingual artery tied if necessary by a separate incision, and the whole tongue, as well as all other diseased structures, removed. The great advantages of the preliminary tracheotomy are that it allows the pharynx to be securely plugged, so that there is no risk of suffocation from blood running into the windpipe, and that it preserves the patient from any risk of contamination from breathing the foul air which is so copiously generated in operations conducted on the ordinary method. Kocher's method has not, I believe, been adequately tried in this country; but he claims four cases of permanent success from it. Numerous other formal operations for removal of the tongue are also described, which differ chiefly in respect of the external incision, whether through the cheek or below the jaw. For these I would refer the reader to Mr. Barker's essay above quoted. The main practical point is as to the possibility of securing better results, in advanced cases, by more extensive operations, implicating the glands as well as the tongue, on which further experience is still required.

The operation of removing the tongue is a severe and a very dangerous one, followed by great distress of mind and body, and is often fatal by its ulterior consequences, even apart from its operative risks, which are nevertheless considerable. There can be no doubt, however, that it has often prolonged life, and rendered its remaining time more bearable to the patient; and therefore, under appropriate circumstances, and at the request of the patient, this chance of relief ought not to be refused to him. At the same time, I think it is one of the most unpromising of all the operations of surgery, and one which no surgeon undertakes without repugnance.¹

It is curious that even after the removal of the whole tongue, as close as possible to its root, the patient is not quite deprived of the power of speech, though the voice is reduced to a hoarse whisper.

In some cases, in which the pain is great or in which the growth of the cancer is rapid, or where it bleeds profusely, the gustatory nerve has been divided to relieve the pain, or the lingual artery has been tied to check growth or to stop hæmorrhage. The division of the nerve is a very simple operation, which can do no harm, and the effect of which ought to be tried in any case in which pain is a prominent feature, or the patient suffers much from profuse salivation. 'The guide to the nerve,' says Mr. Moore,² 'is the last molar tooth. A line drawn inside the mouth from the crown of the last molar tooth to the angle of the jaw would cross it at right angles about half an inch from the tooth. An incision, therefore, in the direction of such a line, three-quarters of an inch in length, and carried through the mucous membrane to the inner surface of the bone, must divide the nerve.' The nerve, as Mr. Moore mentions, is shielded by the alveolar ridge, so that it is necessary to take care that all the soft parts are absolutely severed down to the bone. The operation can be easily and safely performed on both sides, and may afford a good deal of relief for the time.

The ligature of the lingual artery is a much more difficult operation, and one liable to be followed by various grave consequences. It will be found described on p. 584. I have only had occasion to perform it once on a patient rapidly sinking under hæmorrhage, and then it quite failed in checking the

¹ I mean this observation to apply to operations in which the whole or the greater part of the tongue has to be removed on account of extensive cancer. In earlier stages of the disease the excision of portions of the tongue is, no doubt, urgently indicated, and in some it seems to be permanently successful, even when the disease is, in the opinion of good judges, epithelioma.

² 'Med.-Chir. Trans.' vol. xlv.

bleeding ; and in two other cases in which the operation has been performed at St. George's Hospital, its difficulty was more apparent than its utility.

DISEASES OF THE PHARYNX AND ŒSOPHAGUS.

THE affections of the pharynx need not detain us long. Acute inflammation is constant in sore-throat of all kinds, in inflammation propagated from the spine, and in erysipelatous affections spreading inwards. But in all these cases the condition of the pharynx itself is of minor importance. The two former classes of cases have been spoken of along with the affections of the mouth and of the spine. The main importance of the erysipelatous affections, besides the ordinary dangers of erysipelas, consists in the risk of spasm of the glottis, which is peculiarly liable to complicate these cases, and which will be treated of in the chapter on DISEASES OF THE LARYNX.

Affections
of the
pharynx.

Tumours sometimes arise in the pharynx, as in the remarkable instance which Mr. Holt has recorded,¹ in a man eighty years of age. Here a large pendulous fatty tumour springing from the wall of the pharynx extended nine inches down the œsophagus. It had been growing certainly more than twelve years, and occasionally caused symptoms of suffocation. At last, under some circumstances not fully explained, it suddenly obstructed the upper opening of the larynx and at once caused death. In cases such as this, where a tumour of the pharynx is pedunculated, there is no doubt that it should be removed. The patient should be brought fully under anæsthesia, the mouth widely opened by a gag, the tumour drawn fairly into reach by a vulsellum ; then, if the neck is at all broad, or if there is any reason to apprehend hæmorrhage from its division, it should be perforated by a stout double ligature and firmly tied. Or else the tumour should be simply removed, the actual or potential cautery being at hand for use if necessary, and the surgeon should be prepared for the necessity of laryngotomy. The galvanic *écraseur* might also be used.

Tumours
of the
pharynx.

Malformations of the pharynx and œsophagus are not common. There are cases in which the pharynx is congenitally obstructed, and in which it opens into the larynx ; but they are only of scientific interest, as the infant is not viable. More interesting in a surgical point of view is the pouched condition of the pharynx or œsophagus² which is sometimes found, probably either as a congenital defect or as the result of some atrophy and yielding of its muscular walls. A large pouch extends some distance down the tube, and the continuation of the œsophagus appears as an opening some distance above the bottom of the pouch. The result is that the food collects in the pouch, and is often rejected afterwards, producing a suspicion of stricture. On passing a bougie it is liable to be arrested in the pouch instead of finding its way down the œsophagus. The case from which Mr. Pollock's drawing is taken was believed during life to be one of stricture, nor is the diagnosis easy ; but the patient will probably be able sometimes to swallow, the surgeon may happen sometimes to hit the natural opening, and the symptoms will probably not be so urgent as in stricture, so that a conjecture as to the nature of the case may perhaps be formed. No treatment is applicable—the course of the disease will to an attentive surgeon contra-indicate the use of bougies, which, indeed, after the first exploration can only do harm.

Malforma-
tions.

¹ 'Path. Soc. Trans.' vol. v. p. 123.

² A beautiful illustration of this pouched condition will be found in Mr. Pollock's essay in 'Syst. of Surg.' 3rd ed. vol. ii. p. 546.

Stricture
of the
œsophagus.

Stricture of the œsophagus is one of the most terrible diseases which afflict humanity. It occurs 'as the result of several distinct conditions: folds of the mucous membrane; cicatrices after injury; pressure occasioned by neighbouring tumours; thickening and contraction of its walls; or, lastly, and most frequently, cancerous affection of the tube' (Pollock).

Little can be hoped from surgical treatment in these cases. It is therefore of very great importance to distinguish between organic stricture or obstruction from the causes above enumerated, and the somewhat common affection called hysterical stricture of the œsophagus, or nervous dysphagia, which simulates the graver malady.

Nervous
dysphagia.

Nervous dysphagia is more common in women than in men; it is often conjoined with symptoms clearly hysterical; the patient, in spite of alleged long-continued inability to swallow, is in good health and general condition; the dysphagia is not constant; frequently he feels less difficulty in taking solids than fluids, and sometimes the patient can be proved to be able to swallow quite well when no one is looking.¹ Such cases, like cases of nervous disease in other organs, require judicious management more than medical or surgical treatment.

The symptoms produced by stricture of the œsophagus may be summed up in two words—dysphagia and emaciation. The patient is at first able to take small quantities of solid food when well chewed and lubricated; then he is gradually conscious of increasing difficulty, and sometimes the œsophagus rejects the food which it cannot drive down; then he is restricted to fluids, and soon he sinks from exhaustion, if not cut off by some of the local consequences of ulceration about the stricture.

It is by no means easy to distinguish the various forms of stricture from each other. Those which proceed from cicatrization will be known by their history if the accident which caused them is remembered; but this may not be the case. The malignant will differ from the innocent stricture by occurring generally later in life, by the implication of the glands of the neck, by the more rapid cachexia, and by the tendency to implication of the larynx and neighbouring organs. Obstruction from a tumour is generally caused by aneurism of the aorta (at least when produced by a tumour of any other nature the cause is usually obvious), and it therefore occurs always at the part where the aorta is in contact with the œsophagus, so that the difficulty is referred to the upper part of the chest. In such cases very careful examination is necessary before the diagnosis is made, and above all before a bougie is passed. Cases are known in which the instrument has perforated the aneurism and produced instantaneous death. Careful auscultation and percussion of the chest, and the examination of the pulse in both wrists by the sphygmograph, if available, are indispensable; and it should be ascertained whether any of the other symptoms of aneurism are present—the ringing cough, the pain in the back, the so-called rheumatic pains about the neck, &c.

The innocent forms of stricture are fatal only by starvation; but malignant disease very commonly produces death by spreading into the larynx² or into one of the great vessels.

¹ Sir J. Paget, in his interesting essay on 'Stammering with other Organs than those of Speech' ('Clin. Lectures,' p. 82), has pointed out that the difficulty of swallowing may in many of these cases be analogous to that in stammering, viz. an inability from mental causes to co-ordinate the various muscular actions which are necessary to deglutition. If the patient knows he is being watched, or directs his mind too anxiously to what he has to do, he cannot swallow, whilst if he is easy and unconcerned he feels no difficulty. In some cases the patient also stammers in speaking.

² Or it may be itself an extension from the larynx, though this seems less common.

It is justifiable, and indeed necessary in the first instance, to pass a bougie, except in advanced stages of cancer, in which case no mechanical interference is justifiable, since the bougie has often passed through the softened tissue of the cancer into the pleura, pericardium, or great vessels. When the seat of the obstruction has been ascertained, the next question is whether the stricture can be treated. If it is clearly cicatricial, the cicatrix might be divided by either external or internal incision, certainly not without very great danger; but, under circumstances such as these, danger would justifiably be incurred. In the 'New York Medical Record' for November 11 and 18, 1882, Dr. Roe has collected fifteen cases, including two of his own, in which internal œsophagotomy had been practised. In the second of his cases a boy æt. 8, suffering from a stricture the result of swallowing a caustic fluid, was restored to the complete power of natural deglutition by repeated shallow incisions into the stricture, followed by dilatation. The operation, if due care be taken, seems less dangerous than might have been anticipated. In only two of the fifteen cases was death said to be due to the operation itself. Four of the others died after the operation from various causes.¹ Billroth has attempted the extirpation of a cancerous deposit in the œsophagus, but the operation is not usually regarded as justifiable. I have alluded to the possibility, in cases of stricture not obviously malignant, of preserving life by gastrostomy (p. 232) or œsophagostomy (p. 207); and the attempt is certainly worth making. Failing these means, the only thing that can be done is to keep the passage open by means of bougies; and in spite of the known and admitted dangers of the treatment, I cannot but think that it is the best course for the patient, unless the cancerous symptoms are so urgent as to deter the surgeon, from fear of rupturing the œsophagus. If the bougie can be passed, the patient will be able to swallow, and so will be kept free from the terrible pangs of starvation for a time.

Internal
œsophago-
tomy.

In cases where the passage of a bougie is indicated, but where there is difficulty or danger in its introduction, M. Krishaber² has recommended the passage of a tube by the nostril, which is then left in permanently, the patient being fed by injections through it. He refers to five cases in which he has followed this course, one of a malignant tumour implicating the pharynx and larynx, in which the tube was worn up to the time of the patient's death, a period of 305 days, and two others, also cases of malignant disease, in which the tube had been worn for 167 and 126 days respectively, up to the date of the paper. He also teaches that cicatricial strictures may be dilated in the same way as in the urethra by the continuous presence of the catheter, and that this method is of great use in extensive operations on the mouth and larynx; in which cases it should be introduced some days before the operation, so as to insure tolerance of it by the patient.

If nothing else can be done, the prospects connected with the operation of opening the stomach or œsophagus should be explained to the patient, and at his request the operation should be undertaken.

¹ See 'London Med. Record,' April 15, 1883.

² 'Transactions of the International Med. Congress,' Surgery, p. 190. For the ordinary tube Mr. Charters Symonds has substituted a short tube, made of gum elastic, terminating above in a funnel expansion, which rests on the stricture, while the tube passes through into the stomach. The tube is passed by means of a sound inserted into it, which is withdrawn when the end of the tube has reached the stomach. Silk threads are passed through the funnel end of the tube, and serve to withdraw it when necessary. The advantages of this tube are the less irritation which it produces, and that it allows the patient to masticate and taste his food. 'Clin. Soc. Trans.' vol. xviii. p. 155.

AFFECTIONS OF THE INTESTINAL TUBE.

Intestinal
obstruction.

Obstruction of the bowel may be acute or chronic. And it is necessary to distinguish between these two conditions, inasmuch as the causes which give rise to them are not always the same; the symptoms which they present are very different; and the treatment to be pursued for their relief is not based on the same lines.

Acute in-
testinal ob-
struction.

The causes which may give rise to acute intestinal obstruction are very numerous and by no means easy to diagnose. They may be classified as follows: 1. Internal strangulation. 2. Volvulus. 3. Stricture. 4. Foreign bodies. 5. Intussusception.

1. By internal strangulation we mean a condition where a portion of bowel is constricted by a band or loop in much the same sort of way as in an ordinary strangulated hernia, so that the portion of bowel constricted is compressed in such a manner that the circulation through it is interfered with; and if the compression is allowed to continue arrest of the circulation results. This condition may arise from a part of the intestine becoming folded over or looped round an abnormal band stretching from one part of the abdominal cavity to another, or from a portion of gut slipping through some normal or abnormal aperture and becoming there constricted. The bands which give rise to this condition may be formed in several different ways. By far the most common is as the result of old adhesions from some former local peritonitis. (Fig. 303.) In consequence of the peritonitis two portions of gut become adherent to each other, or a portion of gut becomes adherent to the abdominal wall or some other viscus by a band of cicatricial tissue. This band then becomes stretched and elongated and forms a cord-like structure, around which a piece of bowel may accidentally become folded, and, doubling on itself, may ultimately become strangulated, or, slipping between the band and the abdominal parietes, may become compressed between the two and the exact analogue of an ordinary external strangulated hernia be produced. Or, again, bands may be formed by the free edge of the great omentum becoming adherent at some spot to the abdominal parietes or viscera, and the portion bound down, forming a cord-like body around which the intestine slips. Or Meckel's diverticulum (i.e. the vitelline duct remaining persistent) may become adherent to some part of the intestine or to the abdominal wall and so form a loop around which a portion of the gut may become constricted. Or, finally, two appendices epiploicæ may become united together, or one appendix may contract adhesions to some part and thus form a band, which, in like manner, may be the cause of constriction and strangulation of a portion of gut. In other cases, internal strangulation may arise from a piece of intestine



FIG. 303. Internal strangulation of a coil of intestine by a band of peritoneal adhesion, which passes on to the surface and mesentery of a neighbouring coil of gut. The band has been displaced from the groove which it has worked upon the strangulated bowel, in order to show the extent to which the latter is constricted.—St. George's Hospital Museum, Ser. ix. No. 153.

slipping through some normal or abnormal opening. Thus it has been known to arise from a loop of intestine slipping through the foramen of Winslow and becoming strangulated by the free border of the opening. But by far the most common cause is where the gut slips through some abnormal opening; and these openings are generally to be found in the mesentery, and are for the most part congenital, though occasionally they may be due to injury. They are also found in the broad ligament, and rarely in the suspensory ligament of the liver.

2. By volvulus is meant a bending or twisting of a coil of the bowel on itself so as to completely occlude the lumen of the tube. This condition most commonly occurs in the sigmoid flexure of the colon, though it is in rare instances met with in the small intestines and in the ascending colon. Generally it arises from a twisting of the bowel on an axis drawn through its mesentery, and, when it occurs in the sigmoid flexure, is due to an unusually long and narrow meso-colon, so that the flexure forms a narrow loop of considerable length. In this a twist can take place with considerable ease by a rotation of the gut round the long and narrow pedicle. This condition is believed to be induced by long-continued constipation.

3. Stricture of the bowel may cause acute obstruction. In these cases there has been a gradual narrowing of the lumen of the tube from either cancerous deposit in the wall of the gut—by far the more common condition—or from cicatricial contraction, the result of former ulceration and loss of substance. Then sudden occlusion takes place, possibly from some impaction of fæces at the narrowed part, or from some bend taking place in the gut at this point, or, it may be, from sudden swelling from inflammatory exudation; and so acute obstruction is the result.

Cancerous strictures, when primary, are of the epitheliomatous variety. The deposit infiltrates the wall of the gut, generally in an annular manner, causing narrowing of the lumen of the tube, puckering in of the outer coat, and speedy ulceration on the inner surface. The cicatricial strictures are generally due to some primary ulceration, but may in rare instances be caused by some injury to the gut. The most frequent cause of the ulceration is dysentery; less frequently it may be tubercular, and still less commonly syphilitic or catarrhal.

4. The impaction of foreign bodies are sometimes the cause of acute obstruction. Amongst the most common of these are gall-stones which have found their way into the intestine by ulceration from the gall-bladder; or intestinal concretions, consisting generally of phosphatic deposit around a nucleus composed of some undigested substance. Again, substances which have been swallowed and are able to resist the solvent action of the secretions of the stomach and bowels, as metallic substances, pieces of bone, plates of false teeth, &c., may become arrested in some part of the canal and cause acute intestinal obstruction.

5. When a portion of bowel slips into the tube below, just as a finger of a glove may be shortened by slipping one part of it over the other, becoming telescoped as it were, we have a condition which may or may not give rise to *acute* obstruction. To this the term intussusception is given, and is a condition which must be spoken of by itself.

The symptoms of acute intestinal obstruction usually commence with pain in the abdomen. The patient may be seized quite suddenly with severe pain during some muscular exertion or during straining at stool, and this may be accompanied by a sensation on the part of the patient that ‘something

Symptoms
of intes-
tinal ob-
struction.

has gone wrong' or 'slipped out of place.' In other cases the pain comes on more gradually. It is more or less continuous, but subject to exacerbations—paroxysmal and colicky. It is often referred to the umbilicus, and radiates from this point over the rest of the abdomen. It is not, as a rule, increased by pressure. Vomiting is an early symptom; in fact, in cases of very acute obstruction, rejection of the contents of the stomach almost immediately follows the advent of the pain. Subsequently copious and persistent vomiting occurs, independent of taking of food; and after a time it may become stercoraceous. The occurrence of true stercoraceous vomiting depends on the part of the intestinal tube which is obstructed; if the upper part of the small intestine is occluded, the contents of the bowel above the obstruction, which alone are rejected, will not possess the feculent odour, and therefore true stercoraceous vomiting will be absent; if the obstruction is in the lower part of the ileum or in the large intestine, it will, on the other hand, be present. The occurrence of stercoraceous vomiting is usually attributed to inverted peristaltic action, but this is not necessary to produce it. It may be, and probably is, caused by the ordinary peristaltic action of the bowel driving its contents against the obstruction and so inducing a backward axial current, whereby they are poured into the stomach. The patient presents very marked symptoms of vital depression, and rapidly loses strength. The abdomen may become distended and tympanitic from collection of flatus in the portion of intestine above the seat of obstruction, the amount of distension varying with the seat of the stricture. There is constipation, more or less complete; but this is by no means a prominent symptom in acute intestinal obstruction. The urinary secretion is sometimes diminished. This diminution may depend partly on the lessened quantity of fluid in the body, from the amount lost during the persistent vomiting, but may also depend partly on the damage inflicted on the nervous system, for it is always most marked in those cases where the obstruction is most acute. If unrelieved, the patient becomes collapsed, his temperature falls below normal, his pulse becomes very quick and weak, and his features assume a pinched and peculiar expression indicative of suffering, exhaustion, and anxiety. He generally succumbs on the fifth to the seventh day from exhaustion.

Chronic
intestinal
obstruction.

Chronic intestinal obstruction, like the acute, may arise from several different causes, and these causes to a certain extent are the same as those that produce the acute form of the disease; for it not unfrequently happens that acute strangulation may supervene upon chronic obstruction. The causes are: (1) stricture; (2) pressure on the gut of a tumour growing near it; (3) faecal accumulation; (4) intussusception.

(1) Stricture, either cicatricial or malignant, may produce either acute or chronic obstruction. What generally occurs in these cases is that the patient presents, for a variable period, symptoms of partial obstruction, and then sudden complete occlusion is brought about, leading to acute symptoms. (2) Pressure of tumours growing in the abdominal cavity may cause chronic obstruction. Thus large fibroids of the uterus, ovarian tumours, or a retroverted uterus may press upon the bowel, generally the rectum or lower part of the sigmoid flexure, and produce obstruction. Or, again, tumours of the kidney or spleen, hydatid cysts, abscesses, &c., may compress the gut and cause occlusion. (3) Faecal accumulation is another cause of chronic obstruction. The accumulation almost always occurs in the caecum, which becomes filled with large masses of hardened feculent matter. The condition is due to loss of power in the muscular coats of the gut to force its contents onwards. The faecal

matter, therefore, accumulates and becomes hardened from absorption of its more watery parts, and at last complete obstruction takes place. (4) Intussusception may assume a chronic form, especially in the adult. It will be considered later on. The symptoms of chronic obstruction are not nearly so marked or so clearly defined as in the acute form of the disease. The onset is generally very gradual, and the earlier symptoms are frequently ascribed to indigestion. The patient has an attack of 'colic,' pain in the abdomen, vomiting and constipation. This is relieved by medicine, and for a time he is apparently quite well. Then a second attack, and a third, come on, and the symptoms are more severe and more persistent, and the constipation more difficult to overcome. The abdomen becomes slowly distended, the constipation more pronounced, and eventually the disease may culminate in complete obstruction, and the constipation then becomes the prominent symptom. In other cases, complete obstruction may be the earliest sign. The patient may have been going about his usual avocations, may partake of a hearty meal, and this may be followed by pain in the abdomen, sickness, and complete constipation. There may be comparatively little constitutional disturbance at first, but after a time eructations, retching, and vomiting set in. The abdomen becomes distended, so that the coils of intestine can be traced beneath the abdominal wall. The patient eventually dies, worn out by pain, vomiting, and inability to take food. The progress of the case is, however, very gradual, and he may live for five or six weeks after complete obstruction has taken place.

The diagnosis of the situation and nature of an intestinal obstruction is a matter of very great difficulty, and requires the most careful attention on the part of the surgeon. The first point is to distinguish, if possible, the part of the bowel affected, especially as to whether the obstruction is situated in the small or large intestines. The main diagnostic symptoms are these: the higher the obstruction is situated in the intestine the sooner will the vomiting commence; but if the obstruction is high up it will not, probably, become fecal. The amount of nourishment which the patient has taken will, however, influence this to some degree. Usually he is both unwilling and unable to take anything; but if the diet has not been restricted, so that the stomach and upper part of the bowel are filled, vomiting will probably commence earlier than would have been the case under more judicious treatment. The amount of distension of the abdomen is also an important index to the seat of obstruction. When the occlusion is high up, say in the jejunum, the stomach and duodenum will be the only parts of the canal which will be distended with air, and the distension of the abdomen will be limited to this region. The distension of the abdomen is greatest in obstruction of the large intestines, especially its lower part, i.e. the sigmoid flexure and rectum. All the symptoms are more acute when the obstruction is high up. When, on the contrary, it is seated in the large intestine or close to the end of the small, the belly will sometimes continue to swell gradually, without any vomiting, for several weeks, and the patient suffers little except the loss of appetite consequent on repletion and constipation. Another most important diagnostic sign is the quantity of water which can be injected into the bowel. If the obstacle is situated at the sigmoid flexure of the colon, it is rarely possible to inject more than about a pint and a half before it is expelled, and usually with some force. The higher up the obstacle is situated the larger is the quantity which will pass in; and if the small intestine is the part affected, a very large quantity of fluid may be passed up, especially if the

Diagnosis.

patient is narcotised, and will at first run out quite gently until the bowel is roused to expulsive action. Palpitation of the abdomen is, of course, useful; and it is said that auscultation while the fluid is being injected may sometimes give valuable information of the position of the obstacle, but I have never been able to realise this.

A decision as regards the cause of the obstruction is involved in still greater difficulty, and must be in many cases conjectural only. Nevertheless there are certain points in the history of the patient and his condition which may enable the surgeon to come to a correct diagnosis; and to these we must very briefly allude. In acute obstruction from bands &c. there is often the history of a previous peritonitis. The symptoms are very acute and come on suddenly, often during some muscular effort, as straining at stool, and are accompanied by a sensation on the part of the patient of something having slipped or given way. Volvulus occurs most frequently in males somewhat advanced in life (over forty), and there is usually a history of long-continued and habitual constipation. The onset is sudden, but vomiting does not, as a rule, come on early. There is usually extreme distension of the abdomen; especially marked, in cases of twists in the sigmoid flexure, in the left inguinal region. There is no tumour to be felt through the abdominal parietes. In a certain percentage of cases there is discharge of blood per anum. In obstruction from gall-stones, intestinal concretions, or foreign bodies in the gut, some assistance may be derived from the patient's previous history. Attacks of hepatic colic or the passage of gall-stones on former occasions would point to the first condition as the cause of the obstruction; whilst the history of a foreign body having been swallowed would indicate that the obstruction might be due to this cause. If the gall-stone or foreign body is large it may sometimes be felt by careful exploration through the abdominal wall, especially as in these cases the distention is slight. The pain is usually very severe, and vomiting appears early. In obstruction from stricture, the age of the patient in the malignant form, and the previous history in the non-malignant variety, should be considered. Malignant stricture rarely occurs before the age of forty, and in the non-malignant form there is usually the history of dysentery or syphilis, or some symptoms of a tubercular diathesis which will constitute an indication as to its nature. In both forms there is the history of attacks of pain, vomiting, and constipation, with intervals of apparent health. In many there is a history of constipation, with diarrhoea. When the stricture is in the large intestine, as it most frequently is, there is gradual and progressive distension, and very frequently, in the malignant form, the occasional passage of blood by the rectum. In some cases a tumour may be felt through the abdominal parietes, and there is frequently rapid emaciation and failure of strength. In obstruction from fæcal accumulation there is the history of long-continued constipation, with dyspeptic symptoms. The abdomen fills gradually, and very often a distinct tumour may be perceived, the substance of which is to some extent soft and will take the impression of the fingers; and its size sometimes varies with the state of the bowels.

Treatment
of obstruction.

When complete obstruction has taken place, the patient must be kept at perfect rest. And the first rule of practice is to abstain from irritating the bowels with purgatives, to give nourishment in the fluid form only, and in the smallest possible quantities at a time, and to soothe the patient's suffering with opium, subduing thirst with small pieces of ice kept in the mouth. This treatment, however, has no curative effect, and the question of surgical operation, directed either to relieve the strangulation or to give an artificial

exit to the *fæces* above, will have to be considered. The nature of the operation must vary according to the cause and situation of the obstruction. In cases of internal strangulation there is no treatment likely to prove of much avail but laparotomy. It is conceivable, at all events, that the constricted bowel might be liberated by inverting the patient, kneading the abdomen, &c., and the surgeon might consider himself to be justified in employing these methods before resorting to laparotomy. But in the majority of cases the symptoms are so acute and the chances of relief, either spontaneous or by the means above-mentioned, are so remote that the surgeon, having made up his mind that the case is one of internal strangulation, will best consult his patient's welfare by at once opening the abdomen and relieving the constriction. There is no use in temporising; delay only renders the operation more dangerous and the result more uncertain. In obstruction from volvulus, if the surgeon can satisfy himself that it is in the usual situation—that is to say, in the sigmoid flexure—left lumbar colotomy should be performed, if the symptoms are at all urgent. If not, an attempt may first be made to induce the volvulus to untwist by diminishing its distension by aspirating through the parietes of the abdomen. Personally, however, I should prefer to perform colotomy at once without this preliminary puncture, which cannot, I think, be undertaken without a considerable risk of extravasation of the contents of the bowel into the peritoneal cavity, especially when we consider that the walls of the twisted loop which is punctured are thinned and no doubt rendered rotten by the distension to which they have been subjected. Laparotomy in these cases is contra-indicated; but Mr. Treves¹ recommends that the abdomen should be opened, the gut punctured, and reduction attempted. Should this fail, he would evacuate the involved gut through an opening in the summit of the flexure, unfold the volvulus, and establish an artificial anus, using the opening just alluded to for that purpose. Where the volvulus involves the ascending colon or small intestine, there is no alternative. Obstruction depending on volvulus may be relieved by the simple handling of the intestines necessary to find the seat of the mischief, as in an interesting case recorded by Mr. Barker.² Acute peritonitis, as Mr. Barker remarks, is, so far from being an objection to operation, an urgent indication. In obstruction from gall-stones, intestinal concretions, and foreign bodies, an attempt should be made by treatment to relax the muscular coat of the intestinal canal and allow the onward passage of the foreign body. The patient should be kept absolutely at rest; only such food allowed as will leave the least *fæcal* residue, such as clarified beef-tea, and the patient kept thoroughly under the influence of opium. To this treatment the hot bath may be added, especially if the pain is paroxysmal. Should this treatment fail and the symptoms continue, laparotomy must be performed, the bowel incised, and the foreign body extracted. The wound in the bowel may then be sewn up, or, if the gut is inflamed or ulcerated, an artificial anus may be made, which it may be possible to close at a subsequent operation. In cases of obstruction from stricture of the bowel, the position of the stricture and its nature must be taken into consideration in determining upon the mode of treatment. In stenosis of the small intestine before complete obstruction takes place, careful dieting, with the exhibition of laxatives, will do much to relieve the condition of the patient, but can be only palliative. When complete obstruction takes place, if the stricture is believed to be malignant, the best plan of treatment would appear to be to make an incision on the distended

¹ 'Brit. Med. Journ.' Aug. 30, 1885, p. 389.

² 'Clin. Soc. Trans.' vol. xix. p. 149.

intestine wherever it happens to be perceptible and attach it to the skin (Littre's operation, called also 'gastro-enterotomy' or simply 'enterotomy'), so as to make an artificial anus in the small intestine. This is best done by making a short incision over one of the projecting coils of bowel, as near the cæcum as possible, allowing the bowel to protrude of itself, stitching it to the wound, and opening it without handling the gut in any way. I have performed this operation with advantage, and there are now many successful cases on record.¹ Where the stricture is judged to be non-malignant, the question of resection of a diseased portion of intestine must be considered, and, as Mr. Treves states, 'this operation is not only justifiable, but in selected and proper instances it is the best and perhaps the only means of affording substantial relief or reliable cure.' The bowel is to be exposed by median laparotomy and clamped on either side by a suitable instrument. The diseased portion, together with a triangular piece of the mesentery, is to be removed, and the cut ends sutured together by Lembert's suture; or one end of the gut may be invaginated into the other and sewn there in the manner proposed by Jobert (p. 230). In either operation the cut edges of the mesentery are to be united by a few points of suture.² When the stricture is in the large intestine, palliative measures may be adopted, and will give relief for a very considerable time. Careful dieting, and especially the administration of such food as will only leave the slightest amount of solid residue, and the occasional use of gentle aperients, will keep the patient in comparative comfort for a considerable period of time. If, however, the disease is malignant and situated in the lower part of the large gut, it becomes a question whether its progress may not be retarded by making an artificial opening in the bowel above the seat of stricture, and so diverting the course of the fæces and preventing their passage over the diseased surface. This question will be considered more in detail in connection with the subject of cancer of the rectum. When in these cases complete obstruction takes place, relief can only be given by *colotomy*, opening the bowel above the obstruction, or *colectomy*, resection of the portion of colon implicated in the disease.

When obstruction is the result of fæcal impaction, it may generally be relieved by a full dose of calomel (gr. x.) and the repeated use of copious enemata. If the mass is situated within reach of the anus it should be broken down and removed with a scoop.

Colotomy.

It remains now to say a word or two on the operations of colotomy and laparotomy. And first with regard to colotomy, which may be practised on either side when the seat of obstruction is clearly localised in the large intestine. It is more commonly performed on the left side (descending colon) in obstruction of the rectum, and is more promising on this than on the other side, chiefly because affections of the rectum exhaust the patient less and are more easily diagnosed, and therefore more promptly treated, than those situated higher up. When the obstruction is complete and the flank is distended by the swollen intestine, the operation is an easy one; but when performed for the relief of cancer or other affections which do not produce complete obstruction, and the gut happens to be collapsed, it is sometimes very difficult. The patient is placed on the right side, with a pillow under the flank, so as

¹ See 'Med.-Chir. Trans.' vol. lv.; 'St. Thomas's Hosp. Reports,' 1873; 'Clin. Soc. Trans.' vol. ix. p. 102. In some cases where this operation has been performed, the opening has not been permanent, but has closed just as fæcal fistula does after herniotomy. See a case reported by Dr. Malins, 'Brit. Med. Journ.' Sept. 22, 1883.

² For minute details of the operation see a paper by Mr. Treves, 'Med.-Chir. Trans.' vol. lxxvi. p. 55.

to separate as far as possible the last rib from the crest of the ilium, by arching the body to the right. A line is then drawn from a point midway between the anterior and posterior superior spines of the ilium vertically upwards (Allingham recommends half an inch posterior to this). In this line a point is taken midway between the last rib and the crest of the ilium. This corresponds to the centre of the incision. An oblique incision is now made, four inches in length, and parallel to the last rib, the centre of which corresponds to this point. The following structures are then divided:—

- (1) The skin and fascia.
- (2) The external oblique in the anterior part, and the latissimus dorsi in the posterior part of the wound.
- (3) The internal oblique.
- (4) The fascia lumborum.
- (5) The external border of the quadratus lumborum behind and perhaps some of the transversalis in front.
- (6) The transversalis fascia separated from the fascia lumborum by a cellular interval. After division of the transversalis fascia the sub-peritoneal fat is exposed, and the gut is to be sought for. If distended, it will bulge into the wound and no difficulty will be experienced. If collapsed, it is sometimes difficult to find. The surest guide to it is the lower end of the kidney, the bowel being situated below and in front of this organ. In cases of difficulty it has been recommended to inflate the lower bowel with air or fluid; and Lund has invented an instrument for this purpose, by means of which the gut may be distended. The large intestine can be at once recognised by its longitudinal muscular bands and sacculated appearance. The bowel, having been found, is to be drawn to the surface, stitched to the two edges of the wound, and opened between the stitches to an extent sufficient to admit the end of the finger, after which the coats of the bowel are to be carefully attached to the skin around the circumference of the opening. The intestine will become adherent to the wound before the sutures have come out, and after all has become consolidated and the patient has got up, a plug of ivory or glass can be fitted on to the opening and fixed by an elastic bandage. The bowels will very often regulate themselves, so that the action will occur usually at stated periods and the patient be quite clean and comfortable.

In cases not requiring immediate relief from obstruction, Mr. Davies Colley¹ and some of the other surgeons of Guy's Hospital have lately tried various methods of fixing the bowel in the wound without opening it for a few days in order to avoid the suppuration and sloughing sometimes caused by the passage of the intestinal contents over the exposed surface of the wound, and to limit the extent of the latter. For this purpose a clamp is used at either side of the wound, carrying a button and screw which fixes the intestine. Mr. Bryant and Mr. Howse have tried the plan of merely drawing the bowel into the wound and leaving it there till fixed by adhesions.

When the surgeon has made up his mind to look for the seat of obstruction inside the peritoneum (an operation now usually described by the name of Laparotomy), he usually makes his incision in the middle line through the linea alba. Occasionally, however, the incision is made on the outer side of the rectus muscle, or a prominent coil of bowel may be directly cut down upon wherever it shows itself. The incision in the first instance should be a small one, so as to allow merely of the introduction of a couple of fingers, so that the seat of obstruction may be sought for without freely opening up the cavity and running the chance of the intestines protruding. All bleeding from cut vessels in the abdominal wall should be arrested before the peritoneum is opened. As soon as the serous membrane has been incised, a flat sponge

Laparo-
tomy.

¹ 'Clin. Soc. Trans.' vol. xviii. p. 204.

wrung out in some hot antiseptic solution should be kept over the wound and hand of the operator, and the bowels exposed as little as possible. Above all things, every effort should be made to prevent the escape of the intestines from the wound. The finger of the operator is now to be introduced into the lower part of the abdominal cavity and empty bowels sought for; this when found is to be traced upwards until the seat of obstruction is reached. This is a far better plan than tracing the distended bowel down, as is recommended by some. When the obstruction is found, it must be dealt with according to its nature. If a portion of bowel is strangulated by a band of old peritoneal adhesions, the band may be torn through if it is only a small one; but it is generally safer to ligature it in two places and divide it between the two ligatures. If a portion of gut has slipped through a hole in the mesentery or elsewhere, it must be withdrawn by pulling on the collapsed portion. If a foreign body has to be removed, the portion of gut containing it must be drawn well out of the belly and the edges of the wound carefully covered and protected with sponges and cloths wrung out in antiseptic solutions, so that none of the contents of the gut may find its way into the peritoneal cavity. The bowel is then to be incised and the foreign substance removed. The edges of the wound in the gut may now be stitched to the external wound and an artificial anus formed, which perhaps is the safer course to pursue; or the wound in the bowel may be united by sutures and returned into the abdominal cavity.

The operation of laparotomy is a far more serious and difficult one than the operation of abdominal section for the removal of a tumour, principally on account of the difficulty in dealing with the bowel. In these cases the intestine is distended and protrudes out of the wound directly the abdomen is opened, whereas in ovariectomy, for instance, the bowel is empty, and usually no protrusion takes place. In reducing the protruded bowel in laparotomy it is very liable to be bruised or injured; and it is probably this which often renders the operation fatal. Every effort ought, therefore, to be made to prevent, if possible, the escape of the bowel; and if protrusion should occur, every gentleness must be observed in effecting reduction.

Intussusception or invagination is a common cause of intestinal obstruction. It is much more common in childhood than in adult life. It occurs most frequently at the ileo-cæcal valve, the ileum being invaginated into the large



FIG. 304. Intussusception.—From a preparation in the Museum of St. George's Hospital.

intestine, but may also occur in the small intestine, usually in the lower part of the jejunum or ileum; or in any part of the colon, but most commonly in the descending colon and sigmoid flexure.¹ In children the intestine is so irritable and so lax in texture that it is often found intussuscepted to some extent after death, when there is no reason whatever to think that any such condition has existed during life. This condition must not be confounded with true intussusception.

An intussusception consists of three tubes of intestine. On the outside is the receiving-tube or sheath, consisting of the lowermost part of the intestine involved; within this is the reflected tube, turned inside out, so that its mucous surface is in contact with the mucous surface of the receiving-tube, and its serous surface in contact with the serous layer of the most internal or entering-tube (Fig. 305). Between these two—that is, between the reflected and entering-tube—is the mesentery attached to these two portions of bowel. In intussusception of the small intestine into the large (ileo-cæcal intussusception), the invagination increases at the expense of the entering-tube, or small intestine, which becomes prolapsed, sometimes, to such an extent that it may reach the rectum or protrude from the anus, without the position of the large intestine being altered in the least. This occurred in a case in which I performed laparotomy a short time since, where I gradually pushed back an intussusception from the rectum, through the descending, transverse, and ascending colon, and finally liberated it at the ileo-cæcal valve in the right iliac fossa. In all other forms of intussusception the invagination increases at the expense of the receiving-tube; the line of reflection between the entering and reflected tubes remaining the same, whatever the length of the intussusception.

The causes of intussusception are often uncertain. The greater frequency of the disease in childhood is partly accounted for by the irritation of worms, by a loose and lax mesentery, and by the straining produced by dysenteric diarrhoea. Intussusception sometimes depends on the growth of

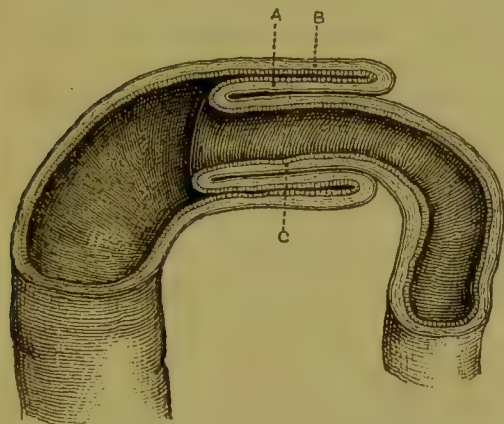


FIG. 305. Diagrammatic section of an intussusception. A. Reflected tube. B. Receiving tube or sheath. C. Entering tube.

tumours from the mucous membrane of the bowel. There is a remarkable preparation illustrating this in the museum of St. George's Hospital, and I recently met with a case in an infant where several small sarcomatous tumours sprang from the surface of the bowel and produced intussusception.

The disease occurs in two main forms—chronic and acute. In the chronic form there is often no stoppage, but the invaginated intestine becomes more and more matted to that into which it is thrust; the passage of fæces through it becomes sluggish, pain comes on from the local inflammation, vomiting sets in and becomes constant, the patient loses appetite and strength, and must inevitably ultimately sink. In acute intussusception the reflected and entering tubes are more or less strangulated; they become injected and swollen, and eventually arrest of circulation takes place and these parts become

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¹ Mr. Treves ('Brit. Med. Journ.' Jan. 3, 1885) divides intussusception into four classes: enteric, 30 per cent.; colic, 18 per cent.; ileo-cæcal, 44 per cent.; and ileo-colic, 8 per cent.

gangrenous. Under these circumstances, if the patient survives, the gangrenous portion may become separated and passed per anum. A natural cure thus results, adhesion taking place between the upper part of the entering-tube and the point of junction of the reflected and ensheathing tubes, so that no extravasation occurs. This never happens in the chronic form of the disease.

Symptoms.

The symptoms in the acute form come on suddenly, there is considerable pain from the first, with complete obstruction, straining to pass fæces, but only a little blood and mucus passing, and vomiting soon sets in, but does not become stercoraceous for some time. A sausage-shaped tumour can often be felt in the part to which the pain is referred, or by examination by the rectum. This tumour is doughy to the feel, becomes tense under manipulation, and may change its position from one part of the abdomen to another. In the chronic form of the disease the symptoms are more obscure. As in the acute, they come on suddenly, and are principally characterised by paroxysmal pain and vomiting, constant tenesmus, accompanied by the passage of blood and mucus from the bowel. There is not, as a rule, complete obstruction, fæcal matter often escaping in small quantities. In these cases the abdominal distension is not great, so that the presence of a sausage-shaped tumour can usually be felt by careful exploration. The diagnosis is difficult in some cases, clear enough in others, when either the intussuscepted portion can be felt or seen from the anus, and the movements of the intestine can be felt in the sausage-shaped tumour, or the latter changes place from one part of the abdomen to another, or when the sudden accession of obstruction, with the straining to pass a little bloody fluid, and the painful sausage-shaped tumour, point almost unmistakably to the nature of the disease.

Treatment.

The treatment consists in endeavouring to disengage the invaginated intestine. There can be no question that in many cases the inflation of the intestine by air or water pumped into the bowel has been followed by the complete subsidence of the symptoms and recovery. In order, however, to be effectual, it should be done early. Kneading the abdomen has also sometimes succeeded. The plan which I adopt, and which I have found successful, is to place the patient under the influence of an anæsthetic as soon as I have thoroughly satisfied myself as to the nature of the case. If a child, he is then inverted and the nozzle of an ordinary enema tube is introduced into the rectum, and carefully packed around with cotton-wool, and the buttock pressed closely together over it by an assistant, so as to prevent the escape of any air. The nozzle is connected by means of an elastic tube with a pair of bellows and air slowly injected. Whilst this is being done the surgeon keeps his hand on the patient's abdomen, feeling if possible the sausage-shaped tumour. He will be sensible of the air passing along the colon, and as soon as the intussusception is reduced he will be conscious of a sudden diffusion of the air over the whole belly, and if the sausage-shaped tumour has been under the hand during the operation he will feel it suddenly fade away from his grasp. This is a plain indication that the intussusception has been reduced, and nothing further requires to be done. It is a good plan to administer a few drops of laudanum in a little starch-water by the bowel, as sometimes the release of the bowel is followed by diarrhœa. Should the tumour remain after air has been injected in as large quantities as is deemed safe, and no symptoms of reduction occur, careful kneading and manipulation of the abdomen should be resorted to, and will in some instances succeed in freeing the bowel. The milder measures failing, I believe the proper course to pursue is to at once perform laparotomy. It is true that a natural cure takes place in a certain

percentage of cases; but this percentage is very small, especially in those patients among whom intussusception is most common. Mr. Treves calculates that 'if 100 cases of invagination be taken in children under eleven years of age, it may be safely reckoned that not more than twelve out of that number will be the subjects of spontaneous cure. Yet no fewer than fifty per cent. of all forms of invagination occur in patients of this age. Moreover, when this 'cure by expulsion' takes place, it frequently only postpones the fatal termination. Hæmorrhage, diarrhœa, the formation of a new invagination, and contraction of the cicatrix formed at the seat of the disease are all causes directly connected with the original lesion which frequently cause death when the invaginated portion has been safely separated and the so-called spontaneous cure taken place. I have very little doubt, therefore, that the patient stands a better chance in these cases, and especially in the chronic form of the disease, by laparotomy, if done early, than by the expectant form of treatment. The operation has undoubtedly in many cases been followed by recovery, and probably the number of successful cases would be largely increased if the disease were more early recognised than it sometimes now is, and operative measures at once resorted to; the milder modes of treatment above referred to having failed. If the operation be delayed for even a short time it may be found impossible to disengage the bowel. When this is the case, the only prospect of the patient's recovery is in the removal of the whole of the affected intestine, the vessels in the mesentery being first secured and the two portions of bowel sewn together; but, as far as I know, the attempt has not yet been successful. Or the portion of bowel having been resected the cut ends of the gut may be sewn to the wound and an artificial anus formed; which, should the patient recover, may be closed at a subsequent occasion.

The operation of laparotomy for intussusception is to be conducted on exactly the same principles as in other cases of obstruction, and the only point requiring especial mention is the way in which the invagination is to be reduced. This should be done by a pushing or kneading motion, the intussuscepted portion being pushed out of the ensheathing part. No attempt should be made to *pull* out the bowel, as this would probably result in laceration of the congested and altered gut.

Little success has as yet attended the operation of resection of a portion of the alimentary canal, but there seems no reason to doubt that, with more improved methods of operating, a great success may attend it in the future, and that in certain cases the justifiability of such operations is unquestionable.

Resections
of portions
of the ali-
mentary
canal.

The pyloric end of the stomach and the neighbouring portion of the duodenum have been removed on account of cancer several times; and in one at least, Wölfler's case, the cure seems to have lasted some time. In two others, Billroth's first case and Czerny's case, the patients recovered from the immediate effects of the operation. The proceeding, however, is one which can very rarely be feasible. I must refer the reader to Mr. Pollock's observations in the 'System of Surgery,' 3rd. ed. vol. ii. pp. 740 et seq. for a description and criticism of the operation.

Two modifications of the operation for removal of the pylorus have lately been introduced; for surgeons have often found the operation impossible when the parts are exposed, in consequence of adhesions, or of infiltration of neighbouring organs. In such cases, an artificial passage has been made for the food by sewing the jejunum to the stomach (gastro-enterostomy)—an

Gastro-
enteros-
tomy and
jejunos-
tomy.

operation which, according to Mr. Golding Bird,¹ had been performed eight times up to the end of 1885, and three of the patients died. In Mr. Golding Bird's own case he attached the highest value to the operation, and treated the case as one of gastrostomy. The patient lived on well for nine days, and died from an accidental cause.

Operative
dilatation
of the
orifices
of the
stomach.

An Italian surgeon, Professor Loreta of Bologna, has performed an operation by which simple non-cancerous strictures of the stomach can be dilated, and thus, as he asserts, without any removal of parts or any permanent fistula. In the case of a stricture at the pylorus, an incision is made into the peritoneum at the end of the stomach and adjacent duodenum pulled out to a sufficient length made into the stomach, one and then the other end through the constricted pylorus and slowly but forcibly pushed through the resisting muscular fibres are completely paralysed. The fingers to be separated from each other from two to three inches. The wound in the stomach is sewn up and the viscera returned to the abdomen. If the obstruction be situated near the cardiac orifice, the same is adopted; but on account of the deep position of the stricture, a more appropriate shape and construction must be employed. Prof. Loreta believes that non-malignant strictures of the stomach, especially the pyloric, is much more common than is generally supposed. If his views are correct, and the operation proves as successful as in his own, it is evident that the sphere of gastrostomy is much enlarged. The pylorus will be much restricted. I must refer the reader to the necessary details as to diagnosis and operative manipulation to the original papers in the Brit. Med. Journ.,² where four cases of cardiac dilatation are referred to, all of which had previously been treated by them were in the practice of other surgeons.

Paracen-
tesis abdo-
minis.

The operation of paracentesis is required, in cases of ascites, especially in ovarian dropsy, to relieve the patient from the distressing symptoms of tension. It is performed by preference in the line between the umbilicus and pubes; though in cases of tense ascites it may become necessary to tap wherever the fluid is found. Care must be taken to avoid the course of the epigastric artery.³ If the patient is unable to lie on his side, he should be instructed to do so, or the emptiness of the abdomen may be satisfactorily ascertained. It used to be usual to tap the patient sitting up, but this is far less convenient than the recumbent position. The patient is to lie on the edge of the bed and turned on his side, so that the abdomen projects beyond the edge of the bed. Then the operation is performed by percussion that the place at which he proposes to tap may be ascertained, and that the fluctuation is plainly perceptible there, and that the fluid is not too thick to be aspirated.

CHOLECYSTOTOMY.

bandage applied. I have never seen any harm in this little operation; no doubt the bowel has been wounded from a too free thrust of the trocar.

The intestine is sometimes deliberately punctured for the relief of tympanitic distension. Such distension is usually acute, and occurs mostly not always, in cases where the bowel is occupied by a tumour which has yet totally obstructed its tube; but when the bowel above is distended, the passage of fæces is prevented either by the paralysis of the distended gut, or by some valve-like effect produced on the tumour by the altered relation of the intestines. In other cases it seems that the distension of the bowel produces a twist which impedes the passage of fæcal matter. Whatever be the cause, where the tympanitic distension seriously impedes the breathing, it gives rise to great distress, and more radical measures are not indicated. It is right to puncture the distended bowel (which is usually the colon) with a fine trocar, and evacuate air or fæcal fluid sufficiently to give relief. In withdrawing the trocar its end ought to be stopped with the finger in order to obviate as far as possible the escape of fæcal gas or fluid into the peritoneal cavity. The general harmlessness of this little operation is attested by a long experience, and in cases of simple twist of the bowel it may prove curative; but there is undoubted risk of extravasation during its performance. After the withdrawal of the cannula the little orifice contracts, and the coats of the bowel being in apposition with some other part of the peritoneal surface, no escape need be feared, and the puncture soon becomes imperceptible or self-termination. The occasional necessity for puncture of the distended bowel in operations for strangulated hernia is spoken of in treating that subject. Paracentesis is also used in hydatid tumours of the liver. I hardly think this the place for discussing the diagnosis or treatment of these cases. They have been successfully dealt with by aspiration, by acupuncture, by electro-puncture, by incision and drainage of the cyst, and by opening the cyst and attaching it to the external wound.

Amongst the mention of the operations on the peritoneal cavity which have been introduced of late years, that of opening the gall-bladder for the removal of impacted calculi should not be omitted. The operation is justifiable when the patient suffers severely from pain, or vomiting, or other consequences of the tumour, or even when the latter is increasing so rapidly that rupture may be apprehended. The position and mobility of the tumour are tolerable indications of its nature, though in many cases no positive diagnosis can be arrived at without exploration. A tolerably free incision through the linea semilunaris will expose the distended gall-bladder, which is to be drawn into the wound, and, after being guarded by packing sponges around it, is to be opened till the finger can be passed in, and then the impacted stones or stones are to be carefully removed until a probe can be passed freely through the duct. The peritoneal surface of the gall-bladder is to be carefully still

Exploration of the rectum with the whole hand.

be obtained in pelvic and abdominal diseases and tumours by passing the whole hand into the bowel, which may be accomplished, under anæsthesia, by gradually dilating the anus with the fingers pressed together in a conical form. The hand may then be buried as far as the wrist, and the parts examined about as high as the kidney, between the hand in the bowel and the one outside, much more satisfactorily than by any other method of exploration. The stretching of the anus leaves some incontinence of fæces, but only for a few days. Care must of course be exercised not to dilate the parts too rapidly and not to rupture the wall of the bowel.¹

Umbilical fistula.

Fistulæ at the umbilicus may result from several different causes, and the discharge from them may be of various kinds. In the first place, and most commonly, the fistula may discharge a fluid having the characters of urine. This arises from a persistence of the urachus, so that a tubular prolongation from the bladder to the umbilicus remains and a small quantity of urine finds its way through it and discharges externally. In many of these cases a small vascular protrusion is found, as the result of the irritation of the discharge, and in the centre of this is the minute orifice of the duct. This protrusion occasionally grows to some size, and often becomes irritable, and bleeds or suppurates. All that is necessary is to pass a ligature firmly round its base; and if this does not succeed in closing the canal in its centre, a slight touch with the actual cautery or the galvano-cautery, followed by careful strapping and approximation of the edges, will generally succeed in affecting a cure.

More rarely, fæcal or biliary fluid is discharged from the umbilicus. Such discharges are connected with some malformation of the omphalo-mesenteric duct, and are, as far as I have seen, incurable. Two cases have come under my observation, in one of which the fluid appeared to be pure bile; in the other, it was mixed with the contents of the intestine, and portions of the food, such as the pips of fruit, would occasionally appear in it.

In other cases the discharge seems merely purulent, and connected with an abscess in the parietes or sub-peritoneal tissue, which has found its exit through the umbilicus and become sinuous. The best way to treat such cases, I think, is to dilate the opening as much as possible with sea-tangle tents and wash out the cavity with carbolic lotion. I have treated a case of this kind in this manner with rapid success.

Finally, there are cases (especially in very fat persons) in which discharge from the umbilicus is produced merely by heat and cutaneous irritation. These cases must be treated like intertrigo—of which, indeed, they are the sequelæ—by great cleanliness, and keeping the parts from rubbing against each other by dusting the skin with oxide of zinc, and inserting tents steeped in tannin or nitrate of silver lotion.

¹ A paper by Mr. Walsham on the exploration of the pelvis by passing the hand into the rectum, in 'St. Barth. Hosp. Reports,' vol. xii., deserves careful study.

CHAPTER XXXII.

HERNIA.

THE term hernia is sometimes applied in surgical language to the protrusion of any of the internal parts through their coverings. Thus we have spoken of hernia cerebri, hernia of the lung, &c. But it is far more commonly applied to the protrusion of one of the abdominal viscera through the parietes, and when used alone it is always in this sense. The hernia generally takes place through one of the natural 'rings' in the abdomen—the inguinal, femoral, or umbilical—and the part protruding is generally the bowel (enterocele), or the omentum (epiplocele), or both (entero-epiplocele).¹ I shall first speak of the general characters common to all forms of hernia before speaking of its special anatomical varieties.

A hernia is at first almost always reducible—i.e. the protruding viscera can be passed back into the belly. It consists of a sac, formed of the peritoneum, and its contents. The sac, in most cases, is a new formation—a protrusion of a portion of the peritoneum which naturally ought not to exist; but there are herniæ which protrude into a diverticulum of the peritoneum existing naturally in the foetal state, which should be closed at birth, but remains, on the contrary, congenitally open. Such herniæ, depending as they do on a congenital condition, are therefore called 'congenital'; not that the hernia itself is necessarily congenital, for in some cases it does not appear till adult life, but that the state which produces it is so. Such are the congenital inguinal and the congenital umbilical herniæ. The non-congenital, or acquired, herniæ occur in consequence of a weakness of the abdominal wall at the seat of protrusion, and possibly also in consequence of an elongated state of the mesenteries of the viscera. The pressure of the viscera gradually pushes the peritoneum through the wall of the abdomen, and as it advances it contracts adhesions to the parts covering it; and when it has emerged from the cavity of the abdomen it swells out into a pear-shaped tumour, the constricted part communicating with the general cavity, being its *neck*, the dilated part, the *fundus*. At first there is nothing perceptible except a little fulness and weakness of the abdominal wall, with unnatural impulse on coughing. Then there is a distinct tumour, which, however, vanishes at once when the patient lies down or when pressure is made on it; but when the tumour has become more developed and of larger size more manipulation is necessary press it back again. The sac, of course, remains, and the viscera immediately re-protrude when the patient stands up, or coughs, or exerts himself. A hernia is never transparent as a hydrocele is; it has almost always an impulse on

Congenital
and ac-
quired
hernia.

General
symptoms
of hernia.

¹ The contents of a hernia are so generally intestine, omentum, or both, that surgeons think but little of anything else, as forming an object of surgical treatment in a hernial sac. Still, as Mr. Birkett says, 'a part of every abdominal viscus has been occasionally found' in a hernial tumour. One of the most interesting of these rare varieties of hernia is that in which it contains the ovary, of which a large number of cases are now on record, both congenital and acquired. In many of these cases the removal of the protruded ovary is advisable if it be the seat of pain and cannot be easily reduced. See a paper by Dr. Barnes, read at the 'Med.-Chir. Soc.' and printed in the 'Ann. Journ. of Obstetrics,' Jan. 1883, and one by Mr. Langton in 'St. Barth. Hosp. Reports,' vol. xviii.

coughing, which is communicated to it through the contents of the bowels acted on by the muscles of the abdomen, and it is traced up and along the canal leading into the abdomen, and by these signs and its reducibility a hernia is immediately recognised in general. But if the contents of the sac have from any cause become adherent to its interior it ceases to be reducible, and is then called *irreducible* or *incarcerated*; and if, besides this, the herniated viscera are constricted, so that the circulation of the contents of the intestines is suspended, it is said to be *strangulated*.

Each of these conditions is marked by symptoms which it is of great importance clearly to recognise; and when the hernia has lost its reducibility, one of the main diagnostic signs being no longer applicable, such symptoms become valuable evidence of the nature of the tumour. The history also ought in such cases to be carefully investigated, for the fact that the patient has for some time been able to push back the tumour at will, or that the tumour has made its appearance quite suddenly, are very strong proofs that it is a hernia.

Irreducible
hernia.

When a hernia is merely irreducible but not strangulated, the impulse on coughing usually remains, and the neck of the sac can be traced up to its exit from the abdomen. The gurgling of the air in the intestine can often be felt on pressure, for the tumour when irreducible is frequently of large size and contains much bowel; and in such cases there may be perceptible resonance on percussion, which is a valuable diagnostic sign. There is often more or less of obstruction to the passage of matters through the bowel contained in the sac, occasioning constipation and vomiting—a condition bordering on and nearly resembling that of strangulation, but distinguished from it by the presence of an impulse on coughing, and by the absence of those more urgent symptoms now to be described.

Strangulation.

Strangulation is marked by total and usually sudden constipation, urgent vomiting, at first merely of food, then of bile-stained matter, next of the contents of the small intestines, and finally of fæces or of matter more or less closely resembling fæces. There is great distress and pain usually in the tumour, and almost always in the neighbourhood of the umbilicus, frequent, irritable pulse, dry and brown tongue, tympanites, and often considerable tenderness of the abdomen and distress of countenance. As the vomit becomes more and more fæcal the tongue becomes drier, hiccough comes on, and the patient sinks into a state of exhaustion, of which he dies, if unrelieved, usually in from ten days to a fortnight. The tumour when strangulated becomes hard, painful, often inflamed on the surface, loses its impulse more or less entirely according to the tightness of the stricture, and the neck is sometimes so constricted that it can no longer be traced along the abdominal ring. The strangulation, even of the omentum only, produces symptoms identical in kind with those of strangulated bowel, though possibly not so severe—a fact which I find it difficult to account for on purely mechanical principles, especially as the omentum, when exposed in the operation for hernia, is constantly tied tightly, in order to remove portions of it, with complete impunity.¹ A strangulated hernia is generally too tightly

¹ The reality of the occurrence of strangulation in pure epiploceles has been to some extent questioned by Mr. Rushton Parker ('On Abdominal Hernia,' p. 20). He seems to think that the symptoms in these cases, usually described as those of strangulation, depend only on obstruction, and refers them to two causes, viz. either to the dragging of the displaced omentum on the transverse colon, or to peritonitis caused by inflammation of the herniated omentum. In other cases he thinks that a small knuckle of intestine which was strangulated had been reduced before the operation. In examining the point

bound down to permit of any correct opinion being formed by palpation or percussion as to the nature of its contents.

Strangulation is to be distinguished from mere incarceration partly by the pain in the sac and around the umbilicus, partly by the greater urgency of the vomiting, partly by the constitutional disturbance which accompanies strangulation and by the absence of an impulse on coughing; but when, as sometimes happens, the hernia, as well as being incarcerated, is also inflamed, the distinction becomes very difficult. If the symptoms of strangulation are not very urgent, but the parts are much inflamed, the hernia often becomes reducible, after the application of leeches to the hernial tumour, with hot baths and free fomentation; and in such conditions the administration of enemata, or even of a purgative, seems often very beneficial.

Inflamed
hernia.

A most formidable complication is gangrene of the contents of the tumour, an event which is often preceded by a cessation of the pain which the patient was suffering, with a continuance or increase of the low fever, with dry brown tongue, small wiry pulse, hiccough, and slow sinking into a state of collapse, with cold, livid extremities. The coverings of the tumour are often œdematous and inflamed. When gangrene is suspected no further attempt at reduction by taxis is justifiable. The tumour must be at once laid open and dealt with according to the state in which its contents are found.

Gangrene.

Another almost surely fatal lesion is the ulceration of the bowel in the line of the stricture. Under continued pressure (especially in femoral hernia from the sharp edge of Gimbernat's ligament) the mucous coat of the bowel becomes ulcerated, and this ulceration gradually extends to the serous or outer coat. Thus the fæces may find their way into the peritoneal cavity. No symptoms are known to mark the occurrence of this ulceration. If perforation occurs before operation the fæces almost inevitably find their way into the peritoneal cavity—a catastrophe marked by intense pain in the abdomen, followed by rapid and fatal collapse. In some rare cases the fæces have been encysted in an abscess external to the general cavity of the peritoneum, and the patient has recovered. After operation this perforation sometimes leads to fæcal fistula, which is not necessarily fatal, nor even permanent.

Ulceration
and per-
foration of
the bowel.

The treatment of most cases of hernia is extremely simple, consisting merely in reducing the herniated viscera into the abdomen and keeping them so. The first indication is fulfilled, when necessary, by manipulation, technically called 'the taxis'; the second, by the application of a truss. If the hernia does not slip up of itself, or under the patient's own manipulation, it is necessary for the surgeon to reduce it; and it is most important that he should be familiar with the way of doing this, and with the signs by which it may be known that it has really been accomplished. It often happens that herniæ of which a portion is irreducible (probably from the adhesion to the sac of a piece of omentum implicating perhaps some of the bowel) are

Treatment.

I referred to the records of strangulated hernia at St. George's Hospital, and found that out of 150 consecutive cases of herniotomy there had been five in which the sac contained omentum only. In one (umbilical) the symptoms might possibly have been only those of obstruction; in a second the hernia was, no doubt, inflamed, though it does not on that account follow that it was not strangulated. In the other three (all femoral) I believe the symptoms to have been due purely to the strangulation of the omentum, and I see no *mechanical* explanation of them. Possibly in these cases the action of the bowels is suspended by some inhibitory influence reflected from the nerves of the strangulated omentum to those of the intestines. The irritation of a stricture might set up such a reflex action when the total destruction of the nervous action by a stout ligature would not. See a letter by me in the 'Lancet,' August 4, 1883.

diminished in size by the reduction of the rest of their contents; and the irreducible part being overlooked, a truss is applied which cannot be worn on account of the pain it produces, or which aggravates the mischief by pressure causing increased adhesion. A still graver error is when the surgeon, in applying taxis for a strangulated hernia, forces a small tumour somewhat higher up the canal and leaves it still strangulated in the abdominal parietes, thinking all the time he has reduced it.

The taxis.

In applying the taxis the surgeon should keep in mind the causes which oppose reduction. They are the tension of the abdominal rings; the sudden increase in the bulk of the contents of the herniated bowel; the implication, or folding in, of the contents into each other, and adhesions between the contents, or of the contents to the sac. The latter is, of course, insuperable except by a cutting operation.

In order to obviate the tension of the rings the patient is to be placed in such a position that the abdominal parietes may be rendered flaccid, by bending the thigh on the abdomen and adducting it a little so as to relax Poupart's ligament and the fibrous structures connected with it. This may be done by an assistant or nurse.¹ Then the sac is to be gently drawn downwards so as to unfold its contents as far as practicable, and to enable the pressure to act directly towards the ring. This being done with the

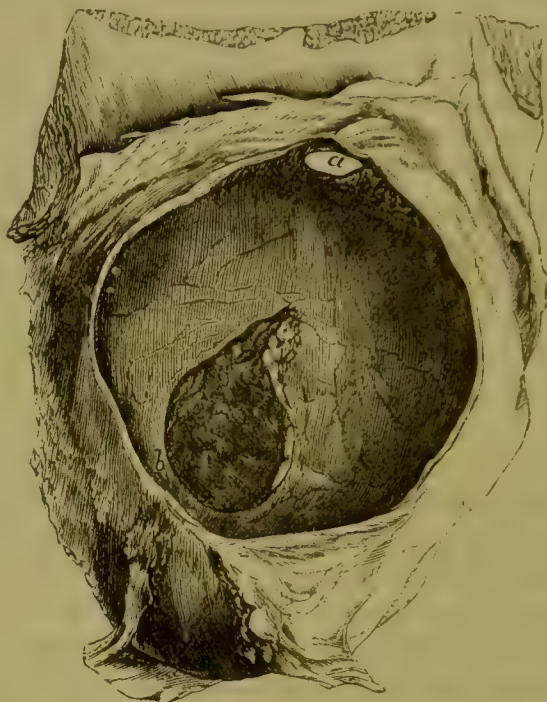


FIG. 306. The sac of a large congenital hernia, showing rupture of the sac by forcible taxis. The hernia had been operated on fifteen years previously. It descended again four days before the patient's admission, and was reduced, but appeared again next day, when forcible taxis was unsuccessfully used. On his admission the scrotum was purple from extravasation. The operation was performed at once, but he died next day from peritonitis. The sac was found to have been torn, and was full of coagulated blood; the mesentery of the herniated bowel had also been lacerated.

a shows the opening made at the operation. The testicle is situated near this opening, but is not visible in this aspect of the preparation.

b shows the rent in the sac extending into the cellular tissue of the scrotum.—St. George's Hospital Museum, Ser. ix. No. 95.



FIG. 307. The gut, with its mesentery, from the same preparation as last figure, showing a rent (*a*) in the portion of mesentery connected with the attached border of the gut.—St. George's Hospital Museum, Ser. ix. No. 96.

¹ Some surgeons believe that an advantage is gained by inverting the position of the body, the pelvis being raised more or less above the head. There is no objection to making a trial in this position if those in the usual one have failed, but it does not seem that much importance is to be attached to it.

fingers of the left hand, gentle pressure is made with those of the right on the more prominent part of the tumour, so as to empty if possible some of the air or fluid in the gut into the abdominal cavity. When this has been done, the contents, so reduced in bulk, generally yield easily to the kneading movement which is now gently applied to the hernia, and the protruded viscera return into the peritoneal cavity. This return takes place in a very characteristic manner. The hernia does not recede gradually, but it vanishes at once, generally with a perceptible snap, or with a gurgle of air and fluid; and if there remains on the mind of the surgeon the least doubt whether reduction is complete, he should not be satisfied without putting his finger fairly through the ring, and ascertaining by a comparison of the two sides that no unnatural fulness is left.

The process of reduction is materially facilitated by anæsthesia, which neutralises the resistance that the patient can otherwise hardly help making when there is any serious difficulty; and accordingly a hernia should not be regarded as irreducible until the taxis has been tried under anæsthesia. It is a very grave, and often fatal, error to use too much force in applying the taxis. Our hospital museums contain a ghastly array of preparations showing the bowel or its mesentery or the hernial sac ruptured by forcible taxis; and we have only too frequent opportunities, in operating for hernia, of seeing the traces of minor violence in extravasation on the bowel or omentum, bloody fluid in the sac, and other lesions, which, though not, perhaps, in themselves fatal, yet add to the dangers of the case, and increase the inflammation set up by the state of the parts.

Dangers of too forcible taxis.

If reduction has failed it must be left to the discretion of the surgeon whether to repeat it or not, looking at the symptoms of the case and the nature of the tumour. There are some herniæ where the constriction is so very tight that the surgeon at once feels convinced that nothing except the division of the stricture can avail to reduce the hernia; and there are some cases in which the symptoms when first seen are so urgent that even a single application of the taxis would be improper, since the bowel may be gangrenous or so nearly perforated by ulceration that the least pressure would rupture it. In either case the operation must be performed at once. But the indications are usually less clear, and it is difficult to lay down any general rule as to when the repetition of the taxis is inadmissible which shall not be liable to frequent exceptions. The one which appears the best, and which is, I believe, usually adopted in the hospitals of this city, is this: when symptoms of strangulation are decided, and the vomit is beginning to be tinged with the contents of the small intestine (i.e. is turning from mere bilious fluid to a dark colour and somewhat offensive odour), do not put off the operation longer, after a final gentle trial under anæsthesia. The means which used formerly to be employed in order to facilitate reduction, such as the warm bath, tobacco enemata, and bleeding, are no longer used, being superseded by anæsthetics.¹ But in voluminous herniæ, in which the symptoms of strangulation are mild, or which are merely irreducible, the application of ice appears to be serviceable.

Question of repetition of the taxis.

Irreducible hernia sometimes becomes reducible after prolonged rest in

¹ I am speaking here of the practice which is pursued at the hospital to which I am myself attached. But the warm bath is used at other institutions. Sir J. Paget lays much stress on its employment, and says that 'it should be used in all cases which are not very bad, unless in old and feeble persons, whom it would depress too much, and in whom fomentations or hot poultices should be substituted'; and he adds that in many cases where the warm bath does not make the hernia reducible at once it becomes so a little later, when the patient has had a few hours' rest in bed.—'Clin. Lectures,' p. 119.

Treatment
of irre-
ducible
hernia.

bed, in aid of which saline purgatives appear valuable. Mr. Langton, in an interesting paper in the second volume of the 'St. Bartholomew's Hospital Reports,' points out how much benefit may be obtained in such cases as have resisted the above treatment by constant and well-graduated pressure. This is effected by an 'accurately fitting bag which should be capable of being laced tightly by means of a running tape, so as to follow the decreasing size of the protrusion. The bag may be supported by a cup-shaped truss, or a ball-and-socket truss may be placed over the neck of the tumour, and the taxis may be employed occasionally, as the size of the tumour lessens.' Pure epiploceles may of course be treated more freely than those tumours which contain intestine. For further details, and for some interesting examples of the success of the treatment, the reader is referred to Mr. Langton's paper.

Accidents
in taxis.

The chief accidents which are known to take place in taxis are rupture of the bowel and 'reduction *en masse*.' The minor lesions above alluded to, of bruising, &c., may be suspected when injudicious violence has been used, but can hardly be recognised. 'The indications of burst bowel,' says Mr. Birkett,¹

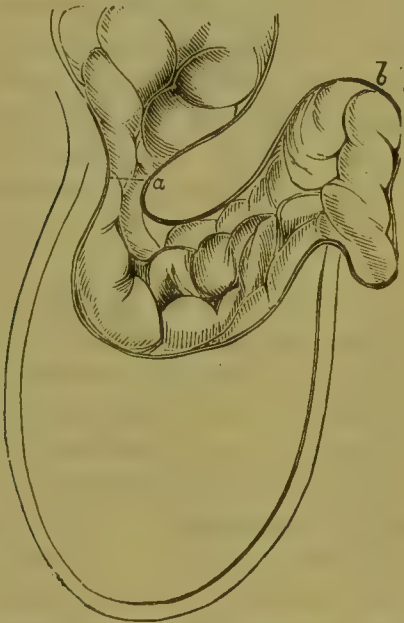


FIG. 308. Diagram of reduction *en masse*. The whole sac and its contents (*b*) separated from the parts investing it, and pushed up into the cellular tissue; the gut still strangulated at the neck of the sac (*a*).

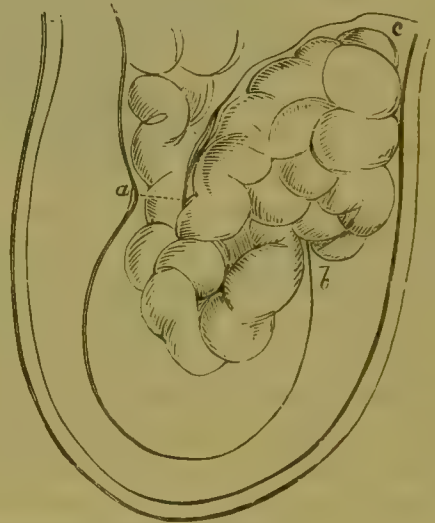


FIG. 309. Reduction *en masse*. The hernial sac torn at *b*, and the bowel (*c*) pushed through the rent into the subperitoneal tissue, but still strangulated at *a*, the neck of the sac.

'are very characteristic. The hernia glides away from the pressure of the finger, and consequently the tumour disappears. This is not, however, accompanied with that sudden and peculiar sensation which the replacement of an unburst bowel within the peritoneal cavity produces. The patient immediately complains of some pain in the abdominal region; vomiting ceases, but pain and hiccough may arise instead; collapse rapidly supervenes, and death closes the scene in a few hours.' Mr. Birkett, however, adds that in rare cases the ruptured part has been closed off from the general peritoneal cavity by inflammation, abscess has ensued, and the patient has recovered with an artificial anus.

'Reduction *en masse*,' or '*en bloc*,' is the term which is used to describe the accident in which the hernia is pushed away from the external surface of the body, and nothing is left perceptible except an ill-defined fulness in the canal; but the strangulation is not liberated. It seems that this may be effected in

Reduction
en masse.

¹ 'Syst. of Surg.' 3rd ed. vol. ii. p. 777.

at least two ways : 1. The old idea was that in these cases the whole of the sac (neck and fundus) had been detached from the tissues around it and pushed into the canal, or even through the canal into the subperitoneal tissue, leaving the gut still strangulated by the neck of the sac (Fig. 308). That this does occur in some cases there is anatomical evidence.¹ But it appears to be more common for the sac to be lacerated, although in these cases its neck may also be displaced and separated from its cellular connections. The laceration sometimes involves the whole sac, in which case the neck of the sac constricting the gut is pushed up the canal and lies in the subperitoneal tissue. Or the posterior part of the sac may be lacerated, and the gut—still constricted by the neck of the sac, or the tissues around it—may be pushed through the rent and doubled up in the subperitoneal tissue under the upper part of the sac (Fig. 309)².

The accident appears to be not very uncommon when much violence is used. Its occurrence should always be suspected when, after forcible taxis, the symptoms are not relieved, and the surgeon may be almost certain that it has occurred when there has not been the usual characteristic sensation of the reduction of bowel (which I have called above a 'snap'), and especially if some ill-defined fulness is still left on that side of the abdomen, yet the still graver symptoms enumerated above as characteristic of rupture of the bowel are not present. The accident occurs both in femoral and inguinal hernia, but seems more liable to happen in the latter, probably on account of the greater length of the sac. Its treatment should be by immediate operation, as will be more fully described in the section treating of HERNIOTOMY.

In all cases in which a patient is discovered to be ruptured, after the hernia is fully reduced he should not be allowed to resume his ordinary

Trusses.

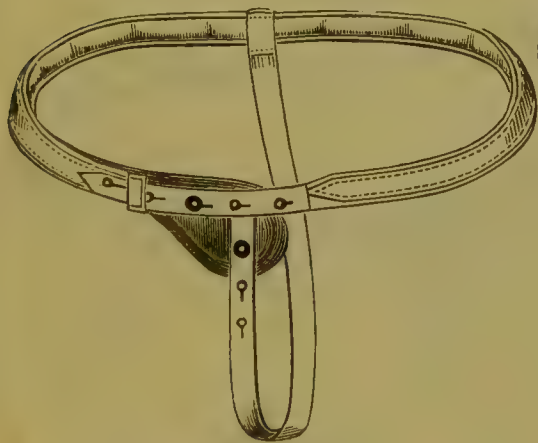


FIG. 310. Right inguinal truss.

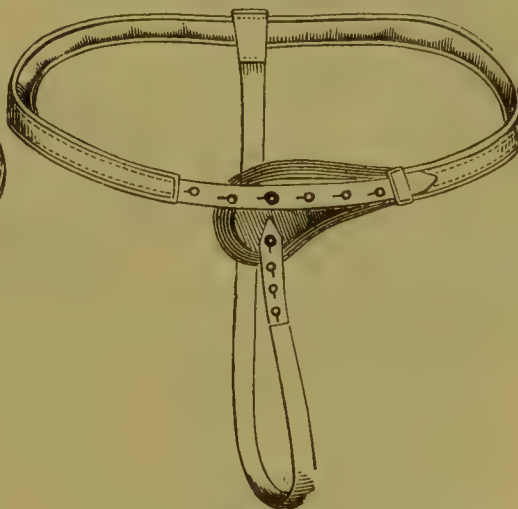


FIG. 311. Left inguinal truss.

avocations without a truss. If the hernia has been strangulated he should not even be permitted to walk to the instrument-maker's shop without having the reprotrusion of the hernia prevented by a carefully adjusted pad and bandage. In no case of reducible hernia should the continual support of a truss be omitted. An impression prevails that an infant may be too young

¹ See especially the cases related by Mr. Avery, in the 'Path. Soc. Trans.' vol. iii. p. 97, and by Mr. Bryant in his work on the 'Practice of Surgery,' 2nd ed. vol. i. p. 627. Both were cases of femoral hernia.

² See Dr. Broadbent's case, 'Path. Soc. Trans.' vol. xii. p. 97; Mr. Morris's, *ibid.* vol. xxii. p. 148; Birkett, 'Syst. of Surg.' vol. ii. p. 781, 3rd ed.

to wear a truss; but no error can be more unfortunate. It is true that in young infants there is much more difficulty in adjusting a truss, and in keeping it worn without ulceration of the skin, inasmuch as the child is in constant motion, and the truss will be constantly fouled with urine and *fæces*. The parent or nurse should therefore be provided with more than one well-fitting truss, which should be covered with oiled silk, and changed when necessary; and all possible care should be given to see that the truss fits, and to pad it with cotton-wool wherever it threatens to chafe. But so far from letting an infant with hernia dispense with a truss, it should, on the contrary, be worn night and day. For the hernia is usually of the congenital form, and the ring will probably close if the gut be kept out of it,¹ to which end the nurse should be instructed to keep her finger applied carefully to the ring even while washing the child.

A single truss is a spring surrounding the abdomen just below the spines of the ilia, terminating at one end in a pad and at the other in a strap with buttonholes. A button is attached on the back of the pad to which the strap is secured, and the truss is prevented from displacement upwards by a strap fastened to its back part, brought under the thigh, and also buttoned on the pad (Figs. 310, 311). If the ring is very large a tail-piece is attached to the pad, to make pressure over a larger area (Fig. 312). When there is hernia on both sides the spring has a pad at each end, and they are kept in position by a strap passing from one to the other (Fig. 313). The essential requisites of a good truss are that it should fit easily round the body, that its pressure should be directed properly, and should be great enough to prevent the descent of the hernia without being so great as either to be painful to the patient or to cause absorption of the parietes, whereby the ring would be further weakened.

It is wiser in all cases to wear the truss both during the day and night, but, as a rule, it is advantageous to substitute a lighter one at night than that worn in the day.

¹ Opinions seem to differ as to the *probability* of the cure of a hernia by the pressure exercised by a truss on the ring, but no one questions its *possibility*; and as to its occasional occurrence, at any rate in early life, I think I can testify from my own experience.

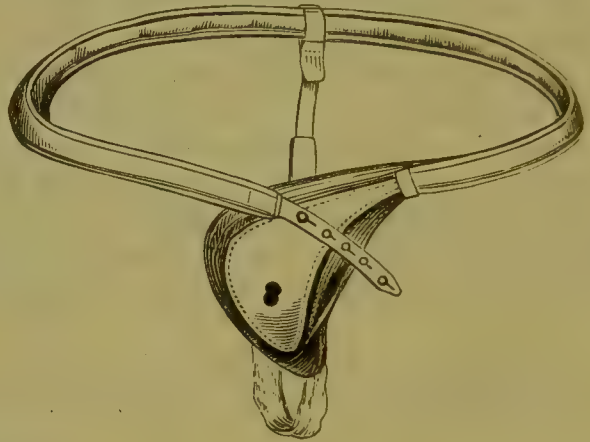


FIG. 312. Left scrotal truss.

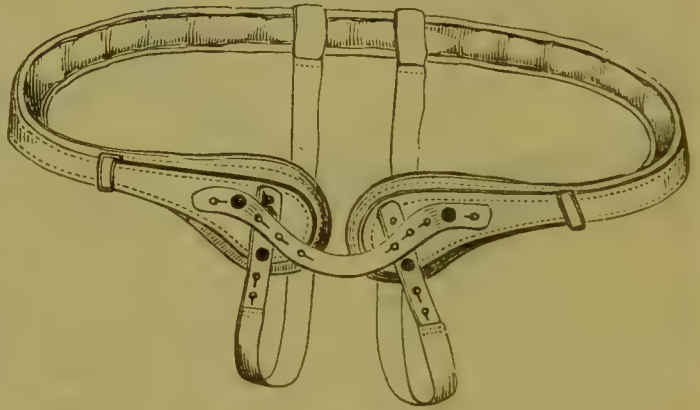


FIG. 313. Double inguinal truss.

The object of a truss is to exert such an amount of pressure upon the ring through which the hernia has descended that its renewed descent shall be prevented in all positions of the body, and during any exertion which the patient may make. For the attainment of this object it is, of course, necessary, in the first place, that the hernia should be completely reduced. This essential precaution is too often neglected by ignorant persons, and it is therefore the surgeon's duty to explain fully to the patient how important it is to make sure of the complete reduction of the hernia before he applies the truss, and also to show him the signs by which he may make sure that the hernia is really reduced. The next point to which attention should be paid is the choice of the form of truss which is to be recommended for the special case in hand. It would be highly undesirable, as well as unnecessary, to speak in this place of the inventions of different instrument-makers or surgeons. Each has its own advantages when constructed on sound mechanical principles, but those in common use and of cheaper construction answer all ordinary purposes well enough. They may be divided into three classes: 1. Those in which the pad which covers the hernial aperture is supported and kept in place by a spring surrounding the pelvis. 2. Those in which the pad is kept in place by counter-pressure applied to the loins.

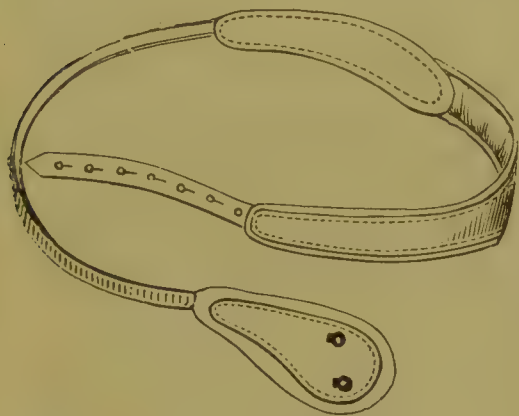


FIG. 314. Spiral spring truss.

3. Those in which the pad is supported on a lever-spring attached to a soft girth or belt.

The common truss is the best example of the first class (Figs. 310, 311). The spring encircles the whole body just below the hips, i.e. the iliac spines, and is prevented from 'riding' or slipping upwards by a strap passing from back to front between the thighs, which is buttoned on to the pad in front. If there is a double rupture both ends of the spring carry a pad, and both pads are

secured by a strap, besides being attached to each other (Fig. 313).

In the spiral-spring truss (Fig. 314) the pad has a spiral spring coiled in it, and the body spring does not encircle the pelvis, but terminates in a larger pad on the loins, in which also a spiral spring is coiled, and which is attached to the pad by a strap passing round the sound side of the body. In the double truss the two pads are buttoned together, and the two back pads are hinged together or made into one elliptical hinged piece.

The ball-and-socket truss (Figs. 315, 316, or Salmon and Ody's) is a modification of this, in which the pad is mounted on a ball-and-socket, or universal joint, and in the single form the spring encircles the sound side of the body, crossing in front of the pubes, so as to direct the pressure of the pad up the inguinal canal.

The moc-main lever truss (Fig. 317) derives its peculiar designation from the Indian name of the silk-cotton tree, from the pith of which its pad is formed. But the main peculiarity of its construction is that all encircling springs are dispensed with. A soft belt encircles the body, and to this the pad is attached, carrying a horizontal lever-spring which passes across to the opposite end of the belt. It is comfortable, but cannot be trusted to when anything like forcible pressure is required.

In applying a truss the first thing is to take an accurate measurement of the patient's body by a tape carried from the centre of the hernial opening to the point just below the anterior superior spine on that side, thence horizontally round the back to the same point on the opposite side, and so back to the starting-point. The length of the horizontal line which joins the two anterior superior spines in front, and the vertical distance of the centre of the hernial

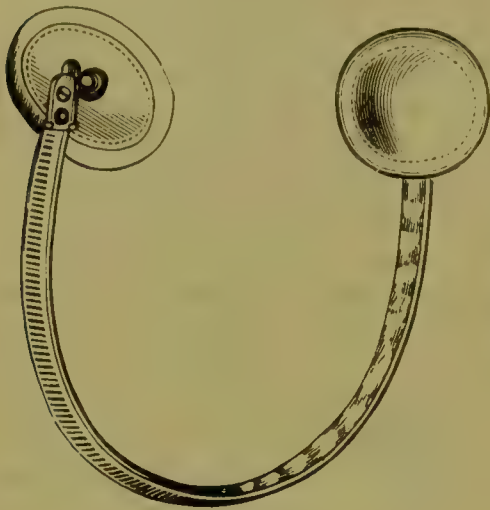


FIG. 315. Ball-and-socket truss.
(Salmon and Ody.)

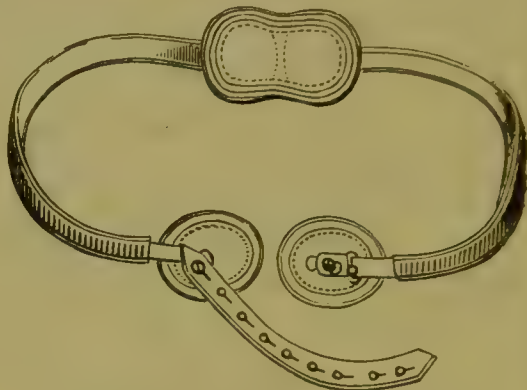


FIG. 316. Double truss.—(Salmon and Ody.)

opening from that line, should also be noted; and if the patient is unusually fat, so that the abdominal parietes are very oblique, it is desirable, as Mr. Wood suggests,¹ to note the horizontal distance of the hernial aperture from a plumb-line let fall from the line which joins the anterior superior spines. In city-practice all this is left to the instrument-maker, but the surgeon ought himself to see that the truss which has been supplied answers its purpose in all respects.

The following are the main qualities of a good truss: 1. It should lie comfortably in the hollow between the buttock and loins, and should be so closely applied to the hips as not to shift in the movements of the patient's body; yet the spring should not be so tight as to gall the skin, nor should the end of the spring project against the wall of the belly. 2. Its pad should cover the whole hernial aperture and the abdominal wall for at least half an inch around it. In large scrotal herniæ a tailpiece to the pad is almost essential in order to prevent the hernia from slipping down under the lower end of the pad (Fig. 312). 3. The pressure should be sufficient to prevent

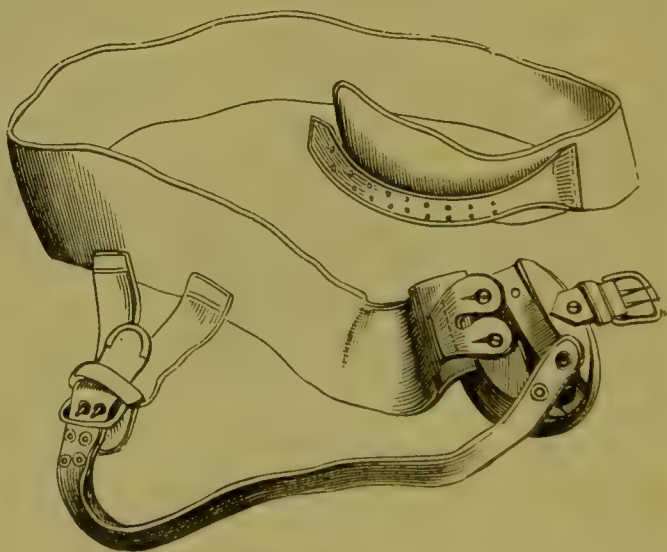


FIG. 317. Moc-main lever truss.

¹ A paper by Mr. J. Wood on this subject, in the 'Brit. Med. Journal,' Oct. 14, 1871, will well repay attentive perusal.

the descent of the rupture in any exertion which the patient may be called on to make, but should not be so severe as to cause the absorption of the abdominal wall and so enlarge the aperture of the hernia. Certain it is that many patients notice the hernia get gradually larger as the truss is worn, and find that the pad has to be gradually increased in size in order to keep up the rupture. Mr. Wood attributes this to the shape of the pad, which is generally made convex, and for that purpose prefers flat pads, believing that the convex pads press the structures inwards which support the abdominal wall behind, and so destroy their valve-like arrangement.¹ This may fairly be doubted, and it seems to me that the convex shape of the pad is really better, since it buries itself in the skin and fat (beyond which no effect, I think, is produced by the shape of the surface), taking a better hold of the parts, and so saving force in the spring. But whatever shape of pad is adopted, it ought to be supported with the least force possible, in order to prevent the escape of the rupture; otherwise, not only will its application be irksome, but the ring will certainly be enlarged. As it is almost impossible to calculate the variations which may be occasioned in the outward pressure of the rupture by the patient's circumstances, those who are liable to be called on for extra exertions at stated times are sometimes usefully provided with two trusses, one for rest, the other for exercise.² An instrument has been devised by Mr. Wood for the purpose of measuring the resistance of a rupture.

Finally, the direction in which the pressure is made must correspond to that of the hernial canal. Direct inguinal hernia comes straight forward out of the belly, and its neck is very short. Oblique inguinal hernia, on the contrary (unless it has been long neglected, in which case the neck is shortened and the enlarged rings are brought almost into a line, giving it much resemblance to the direct form), has a long neck running obliquely upwards and outwards, and the pressure must be made in this direction, and in such a manner that the pad may bring the walls of the spermatic canal into contact and press on the situation of the internal inguinal ring. Femoral hernia, again, has a short neck terminating at a ring which in the erect position is nearly horizontal, so that the pressure is most effectively directed upwards, bringing the pad to bear directly on Gimbernat's ligament. If the rupture has been operated on, the corresponding ring is often enlarged and weakened, and more than common attention must be bestowed to see that the pad is large enough and makes pressure in the proper direction.

The above has reference to inguinal and femoral ruptures only. Umbilical and ventral herniæ are treated by a belt round the abdomen, the belt being laced behind, and provided with elastic sides. This belt carries a pad corresponding to the position of the hernial opening, and so made that its surface is accurately adapted to the shape of the wall of the belly, and its outline overlaps the opening on all sides. The common practice in umbilical rupture in childhood of putting a nipple-shaped pad *into* the orifice seems to me bad, as tending to dilate the opening; at the same time the tendency to natural cure is so great that as a rule no harm follows.

The wearing of a truss may, as has been said above, prove curative, but this is certainly exceptional. On the other hand, there are cases in which

'Radical cure' of hernia.

¹ On this subject the student may consult with advantage a lecture by Mr. Wood (Renshaw, London, 1886). Mr. Wood recommends that in oblique inguinal hernia the pad should be horse-shoe in shape; in femoral, egg-shaped.

² Persons who are addicted to swimming must have a special truss for the purpose, covered with indiarubber material.

the ring is so large that there is much difficulty in applying a truss; and in all cases a hernia is a grave infirmity, and exposes the patient to constant danger. This danger, however, is extremely slight, if proper care be given to the management of the truss. The chief inconvenience of an ordinary reducible hernia is that it debars the patient from the safe or comfortable pursuit of various athletic sports, and that it constitutes a bar to his entrance into the public services.

For one or other of these reasons the patient often seeks for a radical cure, and many have been the operations proposed for this object. And I think it may be said of all of them, even those most recently devised and most carefully thought over, that they usually fail in their object, unless assisted by the pressure of the truss, that is to say, that they are not really 'radical cures,' as they are generally called. Nor is this surprising. The object of the operation is to close the abdominal ring. Now, this can only be effected in umbilical hernia, for in inguinal hernia an attempt absolutely to close the ring would certainly involve the scrotal cord, and in femoral hernia the femoral vein. In femoral hernia, however, the operation is, I believe, too dangerous to be justifiable. One fatal case attracted some attention a few years since, in which the bowel was perforated in an attempt to close the femoral ring; and I am not aware that the operation has been repeated. In umbilical hernia the radical cure is rarely attempted, since the congenital form usually disappears in after-life, and the acquired form occurs generally in elderly stout people, who are not fit subjects for surgical operation nor given to active pursuits, and the local conditions are also usually very unfavourable. The operation is, therefore, in practice, restricted to inguinal herniæ in the male sex, and I think it ought never to be performed except upon patients who (either themselves or their parents) have been properly informed of its dangers, and who deliberately choose to incur them in order to get quit of the inconvenience. The methods of Wutzer and others, though much vaunted at the time, are now, I believe, admitted to be nearly universally failures.

Wood's
operation.

Mr. John Wood's operation consists in invaginating the hernial sac, together with its intimate coverings of external and internal spermatic and cremasteric fascia, into the inguinal canal, through an incision made in the scrotum. The invagination is then secured in this position, and at the same time the tendinous structures forming the boundary of the hernial canal are approximated by an ingenious application of a subcutaneous wire suture. The mode of applying this suture is very elaborate, and requires the greatest care and attention. The description of its application, and indeed of the whole operation—the success of which depends in a great measure upon accurately carrying out every detail—requires more space than can be afforded here. The reader is therefore referred to Mr. Wood's own description as given in his lectures delivered at the Royal College of Surgeons in 1885.¹

In these lectures he refers to 339 operations in his own practice, of which 59 had failed, 96 had been found to be successful for periods varying from 2 to 25 years, and 152 were satisfactory, but as the period was under two years Mr. Wood hesitated to claim them as permanent cures. In his opinion, however, the percentage of successful cases might be put as high as 73. When the operation fails, Mr. Wood believes the failure is usually manifest in less than a year. In the subcutaneous operation the mortality has been less than 2 per cent. In the cases operated on by Mr. Wood by the

¹ 'Brit. Med. Journ.' June 1885.

open method, 28 in number, the mortality was 11 per cent. I would refer the reader to Mr. Wood's lectures for a very clear statement of the cases in which operations for the radical cure of hernia are justifiable.

Several other methods are now pretty extensively tried. One, devised by Mr. Spanton of Hanley, consists in the application of a kind of corkscrew instrument (described in the '*Brit. Med. Journ.*' Dec. 11, 25, 1880, and Jan. 8, 1881), which is insinuated into the tissues on both sides of the inguinal canal, after the reduction of the hernia, and left there for about a week until the parts are supposed to be quite consolidated, when it is withdrawn. Mr. Spanton, in his latest paper on the subject (*Brit. Med. Journ.* July 22, 1882), states that he had then operated on thirty-four cases, and that of these 'thirty are known to be more or less completely cured'; and in a postscript he brings the total up to fifty-one, of whom none had died. The evidence as to the proportion and permanence of the cure is no doubt incomplete; but the proceeding seems a simple one, and worthy of further trial.

Other
methods of
radical
cure.

Another method is to dissect the sac clear of all surrounding tissues, open it, and see that it is free of any contents; or, if there be any adherent omentum, tie and remove it; then pass two stout carbolised gut ligatures round the neck of the sac and divide it, and, finally, sew the pillars of the ring together with silver sutures, which are left buried in the tissues. Mr. Mitchell Banks of Liverpool described this method in '*Brit. Med. Journ.*' Nov. 18, 1882, and relates the particulars of thirty cases, in nine of which, however, it was a part of the operation for strangulated hernia. Mr. Banks's operation is, no doubt, more severe and dangerous than Mr. Spanton's, but it seems more certain, is applicable to all forms of hernia (while Mr. Spanton's only applies to the inguinal), and can be applied in irreducible and strangulated herniæ. Mr. Rushton Parker has also recorded several operations of this kind (*op. cit.* p. 39).¹

Other surgeons ligature the neck of the sac only and do not make any attempt to dissect it out. This, of course, is necessary in operating on cases of the congenital form of hernia. They believe that the shrunken sac may act as a plug, and that the extensive dissection required for its removal is unnecessary. They say that it becomes obliterated by an inflammatory process, and that no trouble, but rather good, arises from leaving it. Some modifications of this operation are adopted; Mr. Stokes,² of Dublin, instead of ligaturing the neck of the sac, opens it and inserts through the opened neck, and close up to the abdominal ring, one or more deep carbolised sutures, according to the size, width, and depth of the neck, and then approximates the pillars of the ring by sutures of a more durable material. This he terms the cure by the peritoneal and intercolumnar suture.

Mr. Hardie³ of Manchester, on the other hand, advocates passing the ligature not only around the neck of the sac, but around the transversalis fascia as well. In the operation he exposes and divides the intercolumnar fascia, and includes in his ligature everything below it, aiming at surrounding a considerable thickness of tissue. He avoids wounding the cord, by puncturing the peritoneum with the needle-point just before coming to it and crossing the neck of the sac, puncturing the peritoneum again on the other side, and so leaving a small portion of the sac not included in the ligature.

¹ See also an address by Sir. W. MacCormac ('*Brit. Med. Journ.*' Aug. 2, 1884) for an interesting series of 16 operations for the radical cure of hernia by excision of the sac.

² '*Dublin Journal of Medical Science*,' Feb. 1884, p. 97.

³ '*Medical Chronicle*,' June 1885, p. 177.

Mr. Fitzgerald¹ of Melbourne has devised an operation for sewing the walls of the spermatic canal together by a crucial stitch of gold wire, which is left buried in the tissues. This is effected by the closure of the canal and pillars of the ring by a subcutaneous cross-suture, the wire being crossed like a bootlace.

Mr. Bull of Dublin recommends closure of the sac by torsion. He isolates the sac from the cord, grasps it with clamp-forceps high up and gives six half-turns, and then ties a ligature of carbolised gut tightly round the neck. The advantages which he claims for this operation are, a more thorough closure of that portion of the sac situated in the inguinal canal, a tightening and throwing into ridges of the peritoneum for a considerable area around the abdominal opening, and a diminution in the chance of septic peritonitis.

Dr. Joseph H. Warren of Boston, U.S., divides the neck of the sac with the galvano-cautery and then sews the divided edges of the sac together with carbolised gut sutures; completing the operation by refreshing the pillars of the ring with the galvano-cautery and then sewing them together with silver sutures, which are left buried. The object of the use of the galvano-cautery is to cause an abundant exudation of plastic material, and thus to increase the strength and density of the new tissue by which the renewed descent of the hernia is opposed.

Finally, the radical cure of hernia by the injection subcutaneously of an astringent solution into and near the canal has been advocated by Drs. Heaton and Warren.² The object of this injection is to cause inflammatory action around the neck of the sac and by cicatricial contraction effect its closure. The material used is a highly concentrated decoction or alcoholic solution of oak-bark. Mr. Keetley, believing that the 'subcutaneous' method might lead to disastrous results, makes an incision down to the external abdominal ring and pushes a blunt probe through the external spermatic fascia, using it as a guide for his cannula. He states that he has operated 16 times, and in 'most cases has had a satisfactory result.'³ The proceeding has, however, found little favour in this country; it is uncertain, painful, and protracted, the cure occupying from two to six months, and the operation requiring to be frequently repeated.

Herniotomy.

The operation for strangulated hernia (called sometimes Herniotomy or Kelotomy) differs but slightly in the different forms of hernia. In many particulars it is the same in all forms.

The only special instruments required in an operation for hernia, besides the ordinary contents of the pocket-case, and an extra pair of forceps with a very fine bite, are the hernia-knife and hernia-director. The knife has a probe-point, and only a very short cutting edge, so as to endanger the bowel as little as possible. It is made either straight or curved, the latter being the most convenient shape for deep-seated constrictions. The hernia-director as usually made is merely a common director much broader than usual. The object of this breadth is to push away the bowel from the edge of the knife when the latter is passed under the stricture. Sometimes the director is provided with wings for the same purpose. It is also advisable to have a stout double ligature ready on a curved needle in any case where the sac may contain much omentum.

¹ 'Brit. Med. Journ.' Dec. 8, 1883.

² See a 'Practical Treatise on Hernia,' Boston, Osgood & Co.; and also 'Dublin Review,' Feb. 1882.

³ 'Index of Surgery,' p. 216.

A free incision is made over the tumour by pinching up a fold of skin and subcutaneous tissue and dividing it. Then the surgeon cuts down with care on to the sac which invests the hernia. This is usually done by pinching up the successive layers of fascia, making a small hole in them, and dividing them on a director to the extent of the original wound. When the sac is fairly exposed the surgeon may examine the structures around its neck carefully, pass his director under any of them which seem to be constricting the hernia, make a sufficient incision into them with the hernia-knife, and then try to reduce the hernia. This will often succeed when the stricture is entirely external to the sac. The hernia being reduced, the wound is sewn up. But if this attempt has failed, or if, from whatever cause, the surgeon is unwilling to try it, the sac is next to be divided. This should be done with all imaginable care. If the tension is not very great it is better to pinch up a fold and divide it, with the edge of the knife turned horizontally so as not to endanger the gut, much in the same way as the sheath of an artery is opened. When the sac is too tense to permit this, it must be gently scratched through till the fluid or gut underneath is reached. In the great majority of cases there is some fluid in the sac, the escape of which gives conclusive proof that the sac has been opened; but in some instances the gut and the sac are completely in apposition, and if the greatest care be not used, the bowel may be wounded, as has often happened. The little hole in the sac is enlarged on a director freely enough to allow a complete view of the whole contents of the sac. The surgeon passes his finger along the gut or omentum to the ring, and then feels the stricture with his nail. He carries the hernia-director along his nail under the stricture, and then insinuates the cutting edge of the hernia-knife beneath the constricting band and divides it to a very slight extent.

Extra-peritoneal operation.



FIG. 318.
Curved hernia-knife.



FIG. 319.
Straight hernia-knife.

If this does not allow the easy reduction of the hernia, another little nick must be made in the same or another part of the stricture, so that the bowel can be reduced without dangerous violence. Finally, the reality of the reduction must be put beyond doubt by passing the finger through into the peritoneal cavity, and then the wound is to be sewn up and a pad and bandage applied.

Every step in the operation thus summarily described has its own difficulties and dangers, and presents many points for observation. I will try briefly to indicate those which are most important.

In the first place, with reference to cutting down upon the sac. It is a matter of great consequence for the rapid and satisfactory performance of the operation to be able clearly to recognise the sac from the membranes which surround it; nor is this at all easy. The subperitoneal fat often so closely resembles the omentum that the operator is tempted to think that he has opened the sac without knowing it. But on trying to pass his finger round

the supposed omentum and up into the peritoneal ring, he will find that he cannot do so, and the error will be manifest. Much time is sometimes lost in carefully dealing with membranes taken for the sac which are merely the investing fasciæ or the membraniform layers of the common cellular tissue. But the sac is usually recognised by its more distinctly fibrous appearance, and by the colour of the fluid which is seen through it.

Formerly the question of the advisability or not of opening the sac was considered to be one of great moment, and much has been written on the subject. But in the present day the matter is regarded as of little importance. The great objection which was formerly urged against opening the sac was that it necessitated opening the peritoneal cavity. At the present time the improved treatment of wounds and the adoption of antiseptic principles has done away with the weight of this objection. And though, even now, it would not be right to say that the sac must necessarily be opened in every case as a matter of routine, still the advantages to be gained by doing so appear, in the majority of cases, to far counterbalance the disadvantages which might arise from adopting the opposite course. These advantages are, first, that the surgeon is enabled to inspect the contents of the sac and ascertain the condition of the gut; secondly, that he runs no risk of returning the bowel with the strangulation unrelieved, as might happen if it were due to a band within the sac and the sac were not opened; thirdly, that he does not return into the peritoneal cavity the fluid in the sac, which is often mixed with blood and inflammatory exudation; fourthly, that he can adopt more efficient means for the permanent closure of the sac and the radical cure of the hernia.

Seat of
stricture.

The seat of stricture varies much for different kinds of hernia. In those forms (as the femoral) which are surrounded by very tight fibrous structures, these are very liable to be the agents, or at least the chief agents, of constriction; while in other cases the sac itself is alone concerned in producing the strangulation, which will last even when the sac and its contents have been liberated from all the surrounding parts, as in reduction *en masse*. This is partly illustrated by the accompanying case and drawing. In such cases it is evident that the constriction cannot be relieved without opening the sac; and in many cases where the main agent of strangulation is anatomically external to the sac, such as the deep crural arch or Gimbernat's ligament in femoral hernia, yet it has become so buried in and incorporated with the neck of the sac that practically it is impossible to divide it external to the tumour.

Inspection
of contents
of sac.

When the sac is opened the nature of the fluid which it contains should be noticed in respect of prognosis. If it be merely thin serum it is so far favourable. Flakes of lymph speak of commencing inflammation of the



FIG. 320. Strangulation of a hernial tumour by the neck of the sac, at the internal abdominal ring. This preparation was taken from the body of a patient who was admitted with a strangulated hernia the size of a man's fist. Attempts at reduction were made in vain; then the patient was put into a warm bath, and fresh attempts were no doubt made, as the tumour suddenly disappeared, although at the time the hernia was said to have disappeared without being touched. The man died six and a half hours afterwards, unoperated on. The hernial tumour was found to be entirely within the inguinal canal, the external ring being quite free.

bowel ;¹ blood, of bruising by taxis or unusual congestion from tight stricture ; a dark, sanious, foetid condition, of commencing gangrene ; and bubbles of gas, of perforation of the bowel, which, if not gangrenous, is ruptured or ulcerated, and should be carefully examined in order to detect the spot.

Now, the stricture being divided, the condition of the sac and of the hernia absorbs the most careful attention of the operator. If there is both omentum and gut in the sac the first point will be so to disengage them from each other that the latter can be separately returned. In some cases the whole sac is closely lined with omentum, and when this is the case there is the

strongest reason for apprehending that it is a case of what Sir P. Hewett has so well described as 'an omental sac,' in which the bowel descends into the centre of a mass of omentum, and is constricted within the sac so formed by the thickening of the tissue at its neck. This may happen in any form of hernia, though it is most common, I think, in the umbilical. In such cases the omentum must be carefully torn or scratched through until the bowel is found inside, when the finger must be passed along the bowel, the director inserted below the ring of the omentum, and the constriction incised just sufficiently to admit of the return of the bowel. Of course, in so dealing with a vascular structure like the omentum, hæmorrhage may be caused ; but unless the omentum be divided the relief of the strangulation is impossible.

Omental
sac.



FIG. 321. An 'omental sac,' from a case in which the stricture was relieved by operation, the omentum being divided in order to reach the bowel. *a* points to a dense fibrous membrane, apparently a condensation of the different fasciæ and neighbouring areolar tissue ; *b*, to the peritoneal sac ; *c*, the external surface of the omentum, which is spread out over the interior of the whole of the hernial sac ; *d*, the wound made in the operation ; *e*, the testicle. This preparation is from one of the cases referred to by Sir P. Hewett in 'Med.-Chir. Trans.' vol. xxvii., and is in the Museum of St. George's Hospital.

The omentum being unravelled, or if necessary divided, the bowel is exposed ; or if there be no omentum in the sac the gut comes into view at once, and the surgeon has to decide what to do with it. In all ordinary

Treatment
of the
strangu-
lated bowel.

cases the decision is instantaneous, and the gut is reduced at once, for it is important not to expose it to the air a moment longer than is necessary. But it is by no means easy to reduce a large tense mass of bowel even when one has it in one's hands, and much patience and care are necessary to avoid bursting

¹ As a surgical curiosity I may mention the presence of a loose body in the hernial sac, an example of which is related in 'Path. Soc. Trans.' vol. xv. p. 96. These loose bodies bear considerable resemblance to the loose cartilages. They are formed by aggregations of lymph and fibroid tissue, often, as it seems, in appendices epiploicæ, which then become detached : sometimes, perhaps, as the result of contusion.

it. In dealing with a large mass of bowel the operator should try to pass one end back at a time (and if the upper end can be distinguished from the lower he had better begin with that) by gently pressing the contents of the bowel into the abdominal cavity and pushing the gut after it with a kneading motion of the two hands. An assistant steadies the rest of the bowel and follows the movements of the surgeon. When once a part of the gut is reduced the rest soon follows. Operators have even found it necessary in cases of extreme distension of the bowels to prick them in one or two places with a needle and evacuate the air from them. As they collapse and the three coats slide on each other the punctures in them no longer correspond, so that no extravasation of fæces follows. But this cannot be necessary except in very rare cases.

If the bowel is found ruptured by previous taxis, or if it gives way during the efforts at reduction, yet is tolerably healthy, the rent should be sewn up with the continuous suture, and the bowel returned;¹ and the same course should be followed in case of an accidental wound or puncture with the knife.

The bowel may be ulcerated at the seat of stricture though healthy in other parts. This ulceration begins on the mucous surface, and is always seen to be more extensive on the inner than the outer face of the bowel, even when it has penetrated all the coats of the gut. It may therefore be going on without being at all perceptible externally; and for this reason, and also because traction on the weakened bowel may break it down, while it otherwise might recover, I think the advice generally given, to draw the herniated bowel down so as to examine the part constricted and ascertain the absence of such ulceration, is mistaken, and I would only do so if the escape of air shows that perforation has occurred somewhere. The reduction of a bowel in which such ulceration is impending is by no means necessarily fatal. I have seen many cases in which after a few days fæcal fistula has followed, in all probability from this cause, yet the patient has completely recovered. The ulcerated part has been shut off from the general peritoneal cavity by inflammatory effusion before perforation has occurred. These fistulæ sometimes remain permanent, but more frequently contract and ultimately heal.

In all states of inflammatory degeneration short of gangrene, I think the counsel given by Aston Key to reduce the bowel into the peritoneal cavity is judicious. It is more likely to recover itself there than if left protruding; and if it does not do so fæcal extravasation into the peritoneal cavity is by no means common. On this subject, however, every operator must follow his own judgment. There is no question that a gangrenous bowel, including one in which gangrene, though possibly not present, is absolutely commencing, should be left in the sac, the stricture having been freely divided. And it is better, I think, to lay the gut open and attach it round the wound, not because there is any chance of its receding into the belly—for it is glued to the neck of the sac by inflammatory adhesions—but in order that the rest of the wound may be united and a free exit left for fæces at the artificial anus. Some operators cut away the gangrenous part of the bowel and attach the two ends of the wound.² And others, again, excise the gangrenous piece, restore the continuity of the bowel, and return it into the abdomen.³ Gangrene of

Ulceration
in the
course of
the stric-
ture.

Fæcal
fistula.

Reduction
of inflamed
bowel.

¹ For a case in which this was done with perfect success see a paper entitled 'Remarks on two Cases of Strangulated Hernia,' in the 'St. George's Hospital Reports,' vol. iii.

² Byrd of Ill. in 'Trans. of Am. Med. Assoc.' 1882.

³ See an exhaustive paper by Mr. Makins ('St. Thomas's Hospital Reports,' 1884), in

the gut, if complete, is unmistakable; its earlier stages are marked by mottled greenish discolouration of the bowel, loss of lustre, and formation of blebs under its serous coat, as well as by the before-mentioned characters of the serum in the sac.

The practice of different surgeons differs in dealing with the omentum when in a morbid state, either from bruising or inflammation. At St. George's Hospital our practice is to surround it at its neck with a stout double ligature and cut it off, returning the stump into the abdomen; the ligature consists of either carbolised silk or catgut, the ends of which are cut off short; and this seems as successful as any other plan. Others prefer simply to leave it in the wound—a plan which has the assumed advantage that the omentum becomes consolidated to the ring and may act as a plug, preventing the return of the hernia; but it has the drawbacks of prolonged suppuration in the unhealthy mass, and possible imperfect closure of the ring, so that instead of being obstructed it may be, on the contrary, kept permanently open. Others, again, having cut off the omentum, tie each vessel which they find bleeding in it. If this plan is adopted, it is best to secure the neck with a clamp before cutting the mass away. The objection to it is that vessels which do not show while exposed may bleed on being returned into the abdomen. On the whole, I have seen no reason to try any other than the first method. When the omentum adheres to the sac it should be removed.

Treatment
of stran-
gulated
omentum.

If the gut be adherent to the sac it is probable that the adhesions will be too extensive to be separated; at least it has been so in the instances which I have seen; and it is necessary to leave the bowel where it is, after dividing the stricture freely. But it is a very unfavourable element in the prognosis.

In cases of suspected reduction *en masse* the operation is of a much more complicated and difficult character. The external opening must be made very free and the ring must be clearly exposed. In cases of inguinal hernia an incision is made on a director up the spermatic canal, and the surgeon feels with his finger for the sac or the bowel as the case may be. When this has been found, it is, if possible, to be exposed by incision; in any case, it must be drawn gently down till the parts are fairly in sight. Then the sac, if unopened, is to be freely incised, and the dissection conducted along the bowel till the seat of stricture is reached and the constricting tissue so fully divided that the finger can be passed along the bowel without resistance into the peritoneal cavity; and not till he is perfectly satisfied that no further constriction exists should the surgeon try to reduce the intestine. In cases of femoral hernia the position of the sac is probably less deep, but care must be taken to avoid injuring the femoral vein.

Operation
in case of
reduction
en masse.

The proceeding described by Mr. Mitchell Banks and Mr. Rushton Parker (see p. 691) is still more plainly justifiable in operations for strangulated hernia than in cases where no strangulation exists, and numerous surgeons have made more or less deliberate and carefully contrived attempts to obtain a radical cure after herniotomy. The best plan seems to be to strip up the neck of the sac (possibly encircled by more or less of the fascia) till the interior of the abdominal wall is reached, and surround it with two or more stout catgut ligatures; and in inguinal hernia the pillars of the ring may be sewn together, though Mr. Parker regards this as superfluous.

Radical
cure after
hernio-
tomy.

which he reviews the whole of the modern work in this department of surgery. He records the result in 55 cases, of which 29 proved fatal. See also an interesting case by Mr. Mitchell Banks, which resulted in a brilliant success. 'Med. Times and Gazette,' vol. i. 1885, pp. 567, 602.

When the operation is completed the wound is to be carefully adjusted and dressed, and then it is usual to put on pressure with pad and bandage. This is perhaps absolutely necessary only when the patient is troubled with cough, in which case the gut might certainly re-protrude; and I have seen it do so even under the pad, requiring the wound to be laid open and the gut reduced afresh. Under ordinary circumstances the bowel would probably remain in place without any special dressing; but the pad does no harm, and gives some support to the wound. It need not be used after the first dressing. The spica bandage is put over the pad, as figured in the chapter on MINOR SURGERY.

After-treatment.

The after-treatment of cases of hernia which go on favourably is generally very simple. No length of constipation is now held to necessitate a resort to purgatives, so long as there are no symptoms calling for their administration. Cases do perfectly well in which the bowels do not act for a fortnight, and even a longer period. And it seems most rational to avoid any disturbance of an intestine which has just undergone so serious an ordeal as exposure and operative reduction involve. Yet the indiscriminate resort to opium and the extreme horror of purgatives which some operators display appear to me unnecessary. Unless there is some special indication from pain or restlessness, or some threatening of peritonitis, I see no reason for administering opium, unless perhaps a single dose or single subcutaneous injection to procure tranquil sleep after the operation. And when the abdomen is becoming distended from constipation much relief will be found from evacuation of the bowels by an enema, or, if there is also a foul state of the tongue, by a gentle purgative.

Sequelæ of strangulation.

A few other points deserve notice in speaking of the phenomena of strangulation, and of the operation for its relief. In the first place, I would observe that although the taxis, if successful in wholly reducing the bowel, is hardly ever followed by any symptoms whatever (so that the patient is at once restored to his usual health), yet this is not always the case. I have seen two or three cases, in the course of an experience of about a quarter of a century, in which peritonitis has persisted after the reduction of the bowel, and has proved fatal.¹ And a case lately occurred under my care in which after the reduction of the herniated intestine it sloughed, and the patient died about ten days after the reduction with very obscure symptoms, which afterwards were found to depend on gangrene of the bowel formerly contained in the sac, without any general peritonitis.

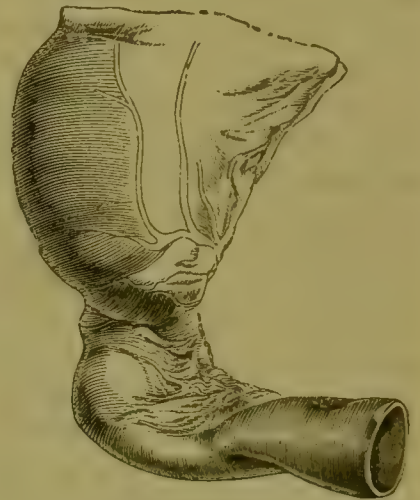


FIG. 322. Contraction of the bowel after strangulation. The portion which has been in the hernial sac is so contracted that, at the time of examination, water would hardly flow through it. The bowel above is much dilated; that below is of the natural calibre. The contraction is due to induration and thickening of all the coats of the bowel. The patient, a woman, had been operated on for femoral hernia. At the operation the bowel was found considerably inflamed. She went on pretty well for a time, complaining, however, occasionally of griping and constipation. The wound healed, and a truss was fitted about a month after the operation, but the griping and constipation became worse, and about eight weeks after the operation she died quite suddenly, as if from perforation of the bowel. On post-mortem examination, however, no perforation was found, nor any peritonitis, but the bowel was much ulcerated on its mucous surface.—St. George's Hospital Museum, Ser. ix. No. 84c.

¹ One of these cases is reported in the 'St. George's Hospital Reports,' vol. iii. p. 326.

The bowel after strangulation, though neither ulcerated nor gangrenous, is often so inflamed as to be unable to resume its functions at once. Thus, even after the complete reduction of the bowel, constipation and vomiting not unfrequently continue; in fact, constipation without vomiting almost invariably follows strangulation, and is, no doubt, salutary, as providing rest for the injured intestines. But sometimes it appears as if the bowel were more permanently injured, as it was in the case from which the accompanying figure was taken, in which the bowel which has been strangulated is seen much thickened, narrowed, and obviously incapable of the natural action, and the distension of the bowel above the seat of stricture is considerable. The history shows this to have been the result of the inflammation caused by the stricture.

Peritonitis after the operation for hernia is a very common cause of death, being sometimes connected with inflammation of the bowel; at others, with inflammation spreading from the wound. It must be treated by free leeching, if the symptoms are those of the acute form of the disease, viz. fever, rapid and hard pulse, great pain in the belly, with frequent vomiting and tympanitis. After the leeches bleeding should be encouraged by warm fomentations, and the addition of mercury to the opium which is indicated in all forms of traumatic peritonitis may be useful. The low form of peritonitis is even more fatal, in which there is little pain and a low irritable pulse, with dry brown tongue, the nature of the affection being marked rather by vomiting and tympanitis than by any other more definite symptoms. In such cases the peritoneal cavity will be found filled with purulent serum, and there will most likely be pus diffused among the meshes of the subperitoneal tissue. Here reliance must be placed mainly on opium, stimulants, and fomentations, all depressing measures being avoided; but the treatment is rarely successful.

Peritonitis
after
operation.

Two different conditions lead to the discharge of fæces from the wound after operation, which ought to be distinguished from each other by appropriate names. They are, however, usually confounded under the common designation of 'artificial anus,' which is only appropriate to one of them. The one, which should be called *fæcal fistula*, depends on the ulceration of the bowel in the course of the stricture which has been above described. A portion of the fæces passes from the wound, but another portion usually, if not always, is voided by the natural passage. In this case, as the ulceration has made its way from the interior or mucous surface, it has caused a limited inflammation of the serous coat, by which the ulcerated portion of the bowel has been glued to the parietal peritoneum coating the wound, the discharge from the bowel is directed externally, and thus extravasation of fæces into the peritoneal cavity is, under ordinary circumstances, prevented.

Artificial
anus.

Fæcal
fistula.

If this should not be the case, profound collapse occurs, speedily followed by death. More commonly, however, there is no very great inconvenience connected with this accident beyond the appearance of fæces in the discharge—an event which may be apprehended when the gut has been seen at the time of operation to be much inflamed, and when (with or without preliminary pain in the wound) the discharge has been noticed to be foul and offensive. I have seen many such cases terminate in complete recovery, the fæces passing by the anus in gradually increasing quantity until the fistula has been soundly healed. Beyond rest in bed and avoidance of constipation I do not know any treatment which can be adopted, nor in cases where the fistula has remained permanent have I ever heard any surgical measures proposed. It would, no doubt, be possible to cut into the abdominal cavity and trace the

bowel to the adherent part, when the ulcerated opening might be clamped and its edges then refreshed and sewn up; but it would be a very dangerous measure. I am under the impression, however, that such an operation has been performed, though I cannot refer to it. Mr. Parker (*op. cit.* p. 29) relates a case in which the fæcal fistula was successfully closed by operation, the ulcerated bowel being still in the hernial sac.

But the condition to which the name of artificial anus is appropriate, and to which it should be restricted, is that which is shown by the annexed illustrations. It is caused by gangrene of a considerable portion of the wall of the gut, leading to a state of parts which can only be remedied by a surgical operation. Whilst the gangrenous part of the bowel has been separating, the living portions have been contracting adhesions to the parietal peritoneum, and the bowel, bent at an angle, is found (as in Fig. 323, A) adherent to the wall of the belly all round. The superficial gangrenous portion of the knuckle of intestine having come away, a large orifice is left (as shown in

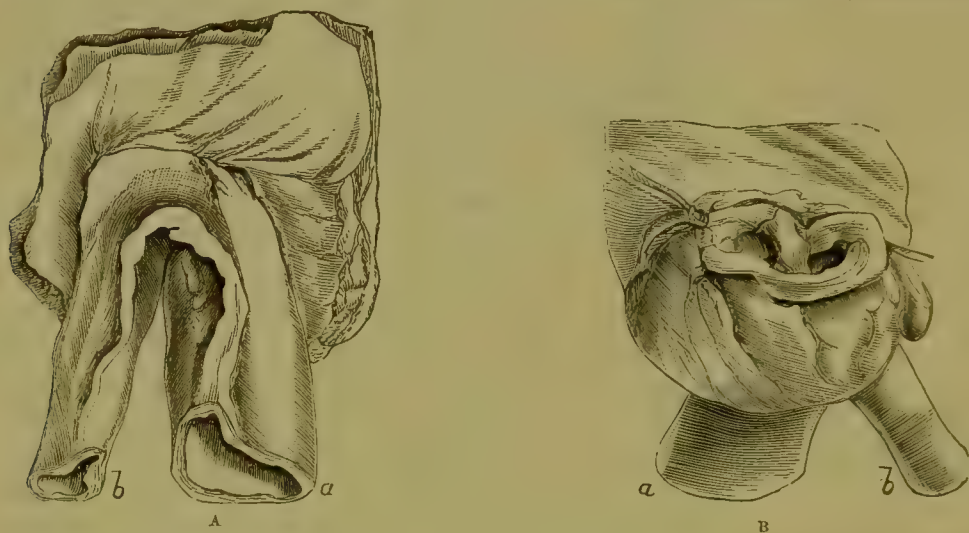


FIG. 323. A, the internal, and B, the external, views of a preparation showing the state of parts in artificial anus after an operation for femoral hernia.

In the first figure may be seen the larger size of the coil of intestine (*a*) which is nearer the stomach and has transmitted the fæces, in comparison with that of the lower coil (*b*), the very acute angle at which they join, and the small extent of the union of their internal or peritoneal surfaces. In B may be seen the aspect of the opening on the skin, and the projecting septum (the éperon of Dupuytren), which divides it into two parts, and which must be destroyed, in order that fæcal matter can pass from the upper to the lower part of the bowel. The projection of this septum would doubtless have increased had the patient lived longer. She was pregnant, and died after miscarriage about three weeks from the date of the operation.—St. George's Hospital Museum, Ser. ix. No. 102.

Fig. B), in which the upper and lower coil are seen to open, much like the muzzle of a double-barrelled gun, except that one is larger than the other, especially after a time. For the lower coil of intestine (*b*), as it no longer transmits any fæces, shrinks up and becomes smaller than the upper, sometimes almost obliterated and cord-like. The septum between the two orifices—called by Dupuytren the éperon, or spur, on account of its prominence—is formed by the posterior wall of the intestine at the junction of the two coils, and it is projected forward by the bowels which lie in the receding angle between the two. The angle of junction is generally very acute, and this spur is sometimes of considerable length. It is this projection which diverts the fæces from the upper bowel through the skin wound and prevents them from passing into the lower part of the bowel. Therefore, so long as this spur remains, the condition is incurable, and the first step in the surgical treatment of artificial anus is so far to destroy the éperon as to permit the passage of fæces directly from the upper into the lower bowel. This is effected by the gradual pressure of Dupuytren's entérotôme. One blade being passed up each

of the coils of bowel as high as is deemed necessary, the two are connected together and are brought into close contact by means of the screw. This is twisted tighter and tighter as may be necessary until the instrument ulcerates through the walls of both intestines and drops off. While this ulceration is in progress, the peritoneal surfaces of the two coils of intestine pour out lymph and adhere together all round the portion included in the blades of the entéro-tôme. This prevents any effusion of fæces into the peritoneal cavity. The contents of the upper bowel (*a*) now pass freely into the lower bowel (*b*) within the peritoneal cavity, the éperon withers away, and the wound con-

tracts. It may possibly heal of itself. If not, its edges must be cautiously refreshed and a piece of skin be transplanted into the opening, if the orifice is too large to admit of the edges being brought into direct contact.

The dangers connected with this operation are mainly two. One is that a coil of bowel may lie in the receding angle between the two coils *a* and *b*, Fig. A, and this may be caught or bruised by the entéro-tôme. To avoid this all imaginable care should be taken to examine well with the two fore-fingers, in order to make sure that there is nothing except the walls of the two coils of bowel between the blades of the instrument; and the instrument should not be applied too tightly at first, but should be screwed up gradually day by day afterwards. The other danger is that the adhesions may not

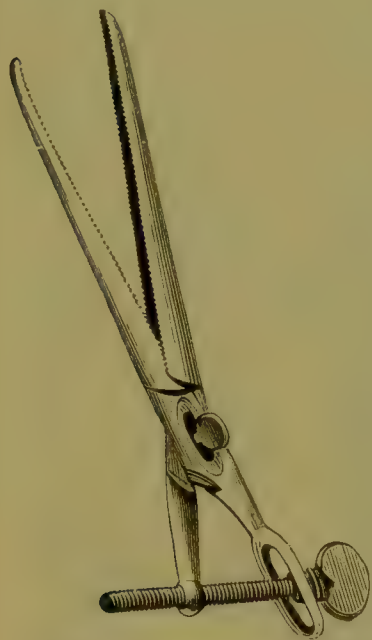


FIG. 324. Dupuytren's entéro-tôme.

form sufficiently, and that the fæces may escape into the peritoneal cavity.¹

A distinct improvement on the uncertain and tedious operation of Dupuytren has been adopted of late years, namely, to lay open the abdominal cavity, excise the affected portion of bowel, and sew the two cut ends of the gut together by Lembert's or Jobert's suture. After the ends are thus approximated, the edges of the opening in the parietes are pared and brought together with suture. The operation is undoubtedly a serious one, but its dangers would not appear to be greater than those of Dupuytren's operation, and can to a great extent be guarded against. A very interesting case in which this proceeding was successfully adopted is related by Mr. Makins.² The whole question is discussed by this gentleman, in his paper above referred to, in the St. Thomas's Hospital Reports. In it he has collected statistics of about 40 cases of resection of the intestine for the cure of artificial anus, in which the percentage of mortality was 38 per cent.

Resection of bowel for artificial anus.

We must now speak of the various anatomical forms of hernia, and of the treatment appropriate to each; and first of inguinal hernia.

Inguinal hernia is divided into two varieties, according to the position of the neck of the sac with regard to the epigastric artery. If the neck of the

Inguinal hernia.

¹ The past experience of surgeons in the use of the entéro-tôme has been summarised by Dr. Heimann ('Deutsche Med. Wochenschr.' Feb. 16, 1883), quoted in the 'Lond. Med. Rec.' May 15, 1883. Two successful cases in his own practice are recorded by Mr. Marsh, 'Brit. Med. Journ.' April 18, 1885.

² 'Brit. Med. Journal,' Aug. 30, 1884.

sac be internal to the artery it is called a direct or an internal hernia; if external, an oblique or external hernia. The latter is much the more common. The oblique variety passes out through the internal or deep abdominal ring, traverses the spermatic canal, appears below the skin through the external or superficial ring, and then drops into the scrotum. Its coverings, therefore, will be the skin, subcutaneous tissue and superficial fascia, the intercolumnar fascia, the cremaster muscle, the infundibuliform fascia, the subperitoneal cellular tissue, and the peritoneal sac.

Different forms of oblique inguinal hernia.

There are numerous forms of oblique inguinal hernia. The first is the *congenital*, in which the internal abdominal ring and the infundibuliform process of the peritoneum have never been obliterated, but the general peritoneal cavity communicates freely with the cavity of the tunica vaginalis. When such a communication is too small to allow the passage of the bowel or omentum it may give rise to hydrocele. Larger communications will give rise to hernia. An example is figured below (Fig. 325) in which this com-



FIG. 325. Non closure of the pouch of the tunica vaginalis, from a case in which this state of things existed on both sides. On this, the right side, there was no hernia, the ring not being sufficiently distended. But on the opposite side a hernia existed, which was strangulated, and was operated on with a fatal result. The patient was five months old.—St. George's Hospital Museum, Ser. ix. No. 82.



FIG. 326. Retained testicle and sac of congenital hernia, seen from the abdomen. The testis is the globular body with a narrow neck seen on the left side of the drawing; the more cylindrical tumour, to the right and behind it, is the hernial sac.

The scrotal cord is attached to the testicle and descends beyond it through the inguinal canal, and the gubernaculum is plainly shown in the preparation attached to the testis. The retained testis is healthy and natural in character, as determined by the microscope; the spermatic cord and the testicle are adherent to the abdominal aspect of the internal inguinal ring.—St. George's Hospital Museum, Ser. ix. No. 91.

munication existed on both sides, and will serve to illustrate the state of parts which predisposes to congenital hernia. Such a state of parts may, however, long continue before the hernia actually makes its appearance. I have known the hernia to show itself for the first time after the age of forty, and even later periods have been recorded. By congenital hernia, therefore, is meant, in surgical language, not precisely a hernia originating at or before birth, but a hernia which takes place through a congenital opening. The peculiarity of congenital inguinal hernia is that the gut and testicle are in contact. When the hernia is fully formed and large the testicle is buried in the bowel, instead of being below or behind the tumour, as in ordinary inguinal hernia. The existence of a congenital hernia may generally be surmised by the history of its sudden descent, in contradistinction to the gradual descent of an acquired hernia; and at the operation the presence of the testicle in the sac is conclusive. Congenital hernia may be known in the

infant from congenital hydrocele by its want of transparency, the hydrocele being always quite transparent, and also by the feeling of gurgling in the bowel, which is rarely absent.



FIG. 327. Diagram of congenital inguinal hernia. The process of peritoneum which passes down with the cord (funicular process) remains freely open; the general cavity of the peritoneum is, therefore, identical with that of the tunica vaginalis testis forming the hernial sac, the bowel contained in which is in direct contact with the testicle.

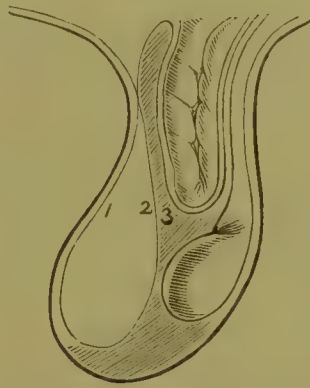


FIG. 328. Diagram of the (assumed) condition of the parts in an infantile hernia. The tunica vaginalis (1) is closed above, at or near the external inguinal ring, but its funicular portion is open. The bowel in the hernial sac lies behind this funicular portion, and is represented in the diagram as having made its way between the funicular process and the cord. The relation of the sac to the cord seems, however, to be variable. The bowel is covered in cutting down from the skin by three layers of peritoneum, viz. 1 and 2, the opposite surfaces of the funicular process, and 3 the anterior layer of the peritoneal hernial sac.



FIG. 329. Another variety of infantile hernia (the encysted form). The bowel, instead of passing behind the closed funicular process, has distended the membrane which closes its upper end, and has pushed itself into the funicular process, the upper or back wall of which envelopes it. In this case, therefore, the hernial sac is furnished by the funicular process itself, and only two layers of peritoneum over the intestine.

There are other congenital conditions which may involve the existence of inguinal hernia. Of these the most frequent is the retention of the testis in the inguinal canal. This keeps the internal ring patulous, and a hernia may easily come down which usually adheres to the testicle, but which may pass

Hernia with retained testis.

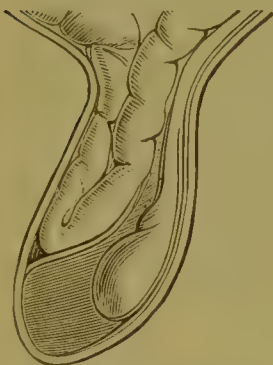


FIG. 330. Diagram of the common scrotal hernia. The tunica vaginalis is seen behind and below, and is represented as distended with a certain amount of hydrocele fluid, but quite distinct from the hernial sac.

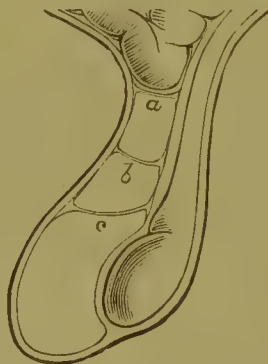


FIG. 331. Diagram of partial obliteration of the funicular process to illustrate the formation of the hernia 'en bissac' and of cysts in the cord (encysted hydrocele of the cord). The cavity of the tunica vaginalis testis is closed at *c*; the funicular process is also separated from the peritoneal cavity at *a*, the situation of the abdominal ring. There is also another septum at *b*. When one or more of these septa are absent or imperfect various conditions occur, as explained in the text.

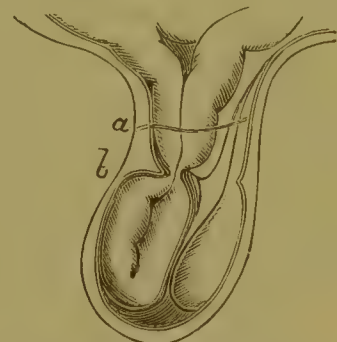


FIG. 332. Diagram of the formation of the 'hernia' into the funicular process of the peritoneum of Birkett and of the 'hernie en bissac' of French authors. Referring to the diagram Fig. 331, the septum or obliteration at *c* is supposed to be absent, so that the tunica vaginalis is open as high as the septum, *b*, which is imperfect, or has given way from some accidental cause. In the diagram the septum at the external abdominal ring, *a*, is drawn as being widely open, but stranguation may occur either in this septum or somewhat lower down at *b*, or at both.

beyond it, even into the scrotum. The engraving on the preceding page (Fig. 326) illustrates this. It shows the testicle, which is adherent to the internal inguinal ring, along with the spermatic cord, and has evidently been

occasionally in the canal and at other times in the abdomen. Connected to the testicle is a hernial sac, which can travel independently of the testicle outside the inguinal ring.

In all cases of hernia it is most necessary to examine the scrotum carefully, and if it is found that the testicle has not descended on that side, then a very careful examination of the inguinal canal should be instituted, in order to see whether the testicle is detained there, and if any bowel can be felt to adhere to it, or to move independently of it. The mere retention of the testis in the canal, together with some accidental lesion, will produce pain and vomiting; and if constipation be also accidentally present, I have more than once seen the case mistaken for one of strangulated hernia. When the nature of the case is plain, if symptoms of strangulation be present, the operation should be at once performed; and it is better, I think, to remove the misplaced testicle. Such testicles are constant sources of trouble, and it seems very dubious whether they are of any real use.

If the hernia be not strangulated the patient should be fitted with a truss with a horseshoe-shaped pad. As it is most essential that in these cases the pad should press on the inguinal canal and internal ring without pressing on the testicle, it is advisable that a plaster-of-Paris cast of the parts should be taken and the pad fashioned on this. If this is done there will be little risk of the hernia coming down and becoming perhaps strangulated, while at the same time the truss will be easily borne by the patient. If the testicle is liable to frequent attacks of inflammation it may be worth the patient's while to submit to its removal, in which case the hernial sac may either be left unopened, or may be removed and its neck stitched up as described on p. 691.

Various
forms of
oblique
inguinal
hernia.

The next form of oblique hernia is that described by Mr. Hey under the name of hernia infantilis, and which is also called encysted hernia. In this form the communication between the peritoneal cavity and the infundibuliform process leading into the tunica vaginalis is obstructed at or about the external (or superficial) ring, but the process itself is not obliterated, so that the cavity of the tunica vaginalis extends up to the external ring. Then a hernia comes down and generally slips behind this upper prolongation of the tunica vaginalis (Fig. 328); but the herniated bowel may bury itself in the upper end of the infundibuliform process and thus be encysted by it (Fig. 329). This may occur in consequence of adhesions having obstructed the neck of the infundibuliform process and formed a membrane. This membrane, being distended by the protruding bowel, forms a hernial sac for it.¹

It seems certain also that there may be two other forms of congenital inguinal hernia, viz. one where the funicular process is obliterated at its

¹ In an interesting and very elaborate paper in the 69th vol. of the 'Med.-Chir. Trans.' Mr. Lockwood discusses the pathology of infantile hernia. He shows that all the specimens of this form of hernia which are preserved in the London museums are of the form shown in Fig. 328, and he argues that there is no proof of the theory that the sac of the hernia is ever formed, as suggested in the text, by a membrane which has obstructed the neck of the infundibuliform process. The cause of infantile hernia is to be sought, according to him, in the action of the gubernaculum testis, which is inserted partly into the peritoneum of the iliac fossa and may drag it down into the infundibuliform process in front of the bowel, pressure from above them completing the protrusion, and this may take place into an open as well as into a closed tunica vaginalis. Thus a hernial sac is formed which hangs down from the ring into the tunica vaginalis, and is often seen to be attached to the epididymis by a vascular fold containing muscle—the remains of the gubernaculum. The paper will well repay study, but the question is so remote from practice that I must be excused from referring to it only briefly.

lower part, so that it is not in communication with the tunica vaginalis, but the upper end and body of this process is not obliterated, so that the peritoneal cavity extends down to the testicle. This remains usually without any hernia till the commencement of adult life, when in some violent effort a hernia suddenly comes down and is often acutely strangulated. Or the state of parts may have been that which has just been described as the initial stage in the formation of infantile or encysted hernia, i.e. the upper end of the funicular process may have been obstructed, and this obstructing medium may have given way, causing a hernia which now is really one of the congenital form, and which also will probably be acutely strangulated. It is in this way that Mr. Birkett explains the indubitable fact of the frequent occurrence of acutely strangulated inguinal herniæ, in some of which the testicle is found in the sac, and not in others. Hey, in describing his infantile hernia, has pointed out that the membrane which shuts off the cavity of the peritoneum from the expanded or infantile tunica vaginalis (Fig. 328) may give way again and admit a hernia into the cavity containing the testicle, the hernia being therefore of the congenital form, though it does not occur congenitally nor from congenital patency of the funicular process; and he cites a passage in which William Hunter had pointed out the possibility of this event, though he had never seen a case (Hey's 'Pract. Obs. in Surgery,' p. 229).

The other forms of inguinal hernia are acquired, i.e. they form slowly, the inguinal canal being in the condition natural to the adult (Fig. 330). The peritoneum, containing omentum, gut, or both, is slowly projected at the internal ring down the scrotal canal. If the hernial tumour has not reached the external ring the disease is termed *bubonocele*. It presents a small rounded swelling, traceable to the internal ring, where it becomes lost without any neck, very little movable, with an impulse on coughing, and reducible under ordinary circumstances. Its diagnosis is sometimes difficult, the affections with which it is most liable to be confounded being enlarged inguinal glands and encysted hydrocele of the cord. Neither mistake is possible, however, when the bubonocele is completely reducible, and presents a distinct impulse. If the symptoms of strangulation should be present they are always a sufficient reason for treating the disease as a hernia and cutting down on the tumour, though there is no doubt that a cyst lying high up in the cord may so far simulate a bubonocele as to deceive the best surgeons, the symptoms having depended on the strangulation of some small deep-seated hernia (such as obturator hernia), or on strangulation of the bowel inside the peritoneal cavity (see Fig. 303, p. 664, and 336, p. 712). Usually, however, a cyst in the cord or an enlarged gland can be pulled down sufficiently to convince the surgeon that it is separate from the internal ring. Besides which, the cyst, if it is at all large, will show its characteristic transparency on very careful examination, and the position of the inguinal glands is not exactly that of inguinal hernia. However, when any doubt exists and the symptoms of strangulation are present, it is far more prudent to ascertain the nature of the case by an exploratory operation.

The common external or oblique hernia forms a large tumour which lies generally above or in front of the testicle, with a long neck reaching up to the position of the internal ring, the cord being generally behind it; though instances are not wanting in which the cord is spread over the front of the tumour, or in which the elements of the cord are separated and lie on either side of the neck of the sac. The abdominal muscles are tightly spread over

the upper part of the neck of the sac in the canal; and I have met with several cases in which strangulation has been produced by tight bands running across it, probably portions of the tendon of the external oblique, on the division of which the hernia was at once reduced. The neck of the sac is often most tightly constricted at the internal ring (see Fig. 320, p. 694), and this lies at a very great depth when there is a large hernial tumour, besides which there are often one or more minor constrictions in the course of the canal which must be divided before the operator arrives at the ring. So that the operation is often both severe and troublesome.¹ The epigastric artery lies close to the inner margin of the ring and at its lower border. The incision into the neck of the sac should, therefore, be directed upwards. When the hernia is of gradual formation and old standing the neck becomes much less oblique and relatively shorter, so that its mouth is more easily reached. Such herniæ, also, are far more likely to be strangulated external to the sac, and to be susceptible of relief by the extra-peritoneal operation.

The operation for bubonocoele is of the same nature as that for scrotal hernia. In both an incision is to be made along the long axis of the tumour, which is most conveniently done by pinching up a fold of skin transversely and transfixing it, the incision being made of sufficient length to give easy access to the neck of the sac at the internal ring. The

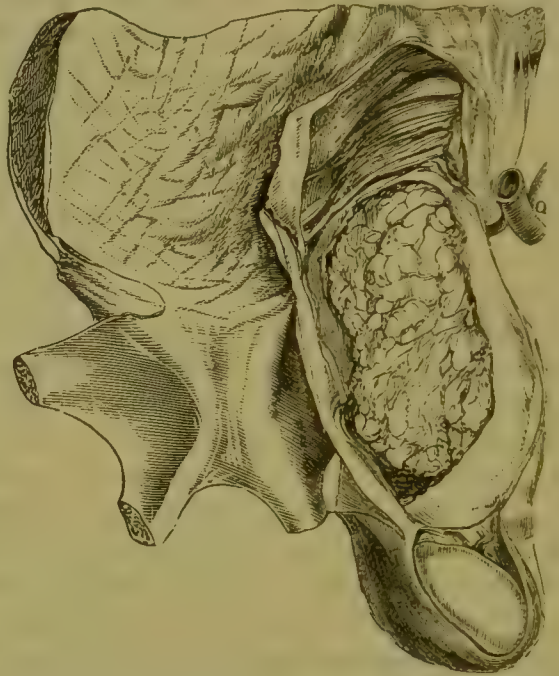


FIG. 333. An oblique inguinal hernia seen from the outside. *a* shows the epigastric artery coming off from the external iliac and winding round the neck of the sac.—St. George's Hospital Museum, Ser. ix. No. 72.

various layers of fascia having been divided successively (on a director, if they are tense), the surgeon may examine for any bands which he can feel constricting the tumour external to the sac, and divide them by passing a probe-pointed bistoury beneath them. If the hernia is still irreducible the sac must be opened and the neck of the tumour traced up into the peritoneal cavity, in doing which the seat of strangulation will be met with. In a voluminous tumour, with a tight, deep-seated stricture, much care is needed (especially with an inexperienced assistant) to keep the bowel out of harm's way while incising the stricture. It is of no use to commence the reduction of the bowel until the stricture has been so thoroughly divided that the finger passes easily into the cavity of the peritoneum; and it is of course necessary to have the bowel and omentum freed from any entanglement with each other, and to ascertain the absence of adhesions.

Direct inguinal hernia is far less common than oblique. It does not occur

¹ Such constrictions sometimes form real double sacs, as would be the case in Fig. 331, if the septa *a* and *c* were imperfect, and the hernia covered by the septum *b*, after passing through them, had become enlarged, or the septa *a* and *c* had contracted so that the gut was strangulated at both points.

congenitally, in the male sex at least. The bowel protrudes in the space denominated the triangle of Hesselbach, which is bounded externally by the epigastric artery and internally by the sheath of the rectus muscle, Poupart's ligament forming its base. Two varieties of this hernia are described in the anatomical theatre as occurring in cases where the obliterated hypogastric artery divides Hesselbach's triangle into two parts. In the ordinary state of parts it seems more common for the course of this obliterated vessel to correspond pretty nearly with that of the epigastric. Its projection inwards throws the peritoneum into two fossæ, the bottom of the internal fossa being at the external or superficial ring, while the bottom of the external fossa will lie at the internal or deep ring when the course of the hypogastric and epigastric vessels correspond, but will be internal to the deep ring when the obliterated artery runs across the triangle; and in the latter case the hernia will push before it the walls of the spermatic canal, and pass down a portion of that canal before reaching the superficial ring. This causes a slight difference in the coverings of these two forms of hernia. The common form of direct hernia is covered by the skin, subcutaneous tissue or superficial fascia, intercolumnar fascia, conjoined tendon, transversalis fascia, and subperitoneal tissue, while the less usual form has the cremaster muscle or fascia in place of the conjoined tendon. This is not a matter of any consequence; in fact, it could only be demonstrated by very careful dissection; what is of more surgical importance is to remember that the neck of the sac may be very close to the epigastric artery. In the ordinary form the epigastric artery is at such a distance as to be quite out of the way in an operation. In all cases, therefore, it is better to incise the neck of the sac directly upwards. Direct inguinal hernia passes at once into the scrotum, and its diagnosis is not usually a matter of any difficulty. The neck of the sac is more superficial than in oblique hernia, and the operation is therefore simpler, but is the same in principle and in most of its details.

Direct
inguinal
hernia.

Inguinal hernia occurs also in females, and a certain amount of protrusion at the external ring and into the top of the labium is very common in female infants—congenital hernia—which as a rule gradually disappears without any treatment, but if unusually large requires the constant application of a truss, just as congenital hernia does in the male. A congenital hydrocele (hydrocele of the round ligament) also occurs in females, and may be mistaken for hernia, though the disease is a rare one. In infancy I am not aware that the difficulty occurs, but in the adult, cases have been recorded in which an operation has been necessary in order to settle the diagnosis. The tense nature of the tumour, its irreducibility, the want of impulse on coughing, and in some cases its translucency, are the chief diagnostic marks; but in this as in all embarrassments of diagnosis, when the symptoms are sufficiently urgent to justify it, an exploratory operation should be early performed. The inguinal hernia of later life in females is of the acquired form and usually direct. No special directions are necessary for the operation in either form.

Inguinal
hernia in
the female.

Femoral hernia occurs more commonly in the female than in the male sex, although it is by no means rare in men. The hernia is never of the congenital form, and therefore occurs very rarely in childhood. There seems no doubt that pregnancy and parturition predispose to it. The neck of the sac is at the crural ring, which is tightly constricted at its inner and upper part by the deep crural arch, the upper cornu of the falciform opening, and Gim-

Femoral
hernia.

Irregular distribution of arteries round the neck of the sac.

bernat's ligament. The pressure of these dense unyielding structures often causes very acute strangulation, in which circumstances the symptoms are urgent and taxis unsuccessful. The neck of the sac can be traced below Poupart's ligament, though its fundus, or the body of the tumour, in many cases rises up on to the abdomen, lying over that ligament. The coverings of a femoral hernia are the skin, the subcutaneous tissue and superficial fascia, the cribriform fascia, the sheath of the vessels, the crural septum, and the subperitoneal tissue. The crural ring, or the mouth of the sac, has on its outer side the femoral vein, and the epigastric vessels lie a little above it; but it has usually no important vessels at its inner and upper angle, where the incision is made to relieve strangulation. The anastomosing artery between the epigastric and obturator passes around the ring, and its size varies considerably, so that sometimes free bleeding occurs in this incision, and in fact I have known such hæmorrhage prove fatal in a case where, the vessels being uninjected, no conspicuous artery could be detected at the post-mortem examination. But in cases of anomalous origin of the obturator artery the trunk of this vessel may entirely encircle the ring, so as to be in danger of being divided at the operation. This is not ordinarily the case even when the obturator comes off from the epigastric, for the anomalous artery usually takes its course towards the obturator foramen on the outer side of the sac, as shown in Fig. 334, and is quite out of harm's way. But when, as in Fig. 335, the obturator vessels pass around the neck of the sac, they are liable to be wounded in dividing the stricture, although they may accidentally escape. In the instance from which that figure was drawn it seemed probable that the vein was wounded at the time of the operation, but the artery escaped, though it gave way afterwards. There was considerable venous hæmorrhage

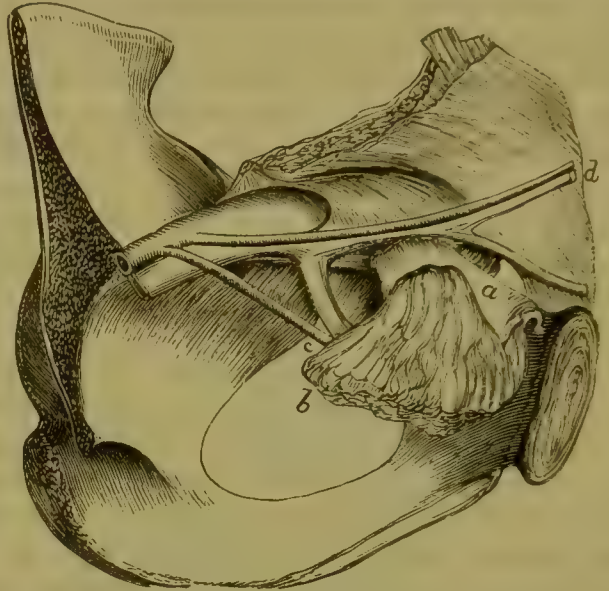


FIG. 334. Irregular distribution of the obturator vessels in a case of femoral hernia. The obturator artery arises from the external iliac, close to the origin of the epigastric; the vein opens into the epigastric vein. As, however, they lie on the outside of the hernial sac, there could be no danger in an operation. *a*, the hernial sac, on the inner side of which the incision would be made in case of strangulation; *b*, its contents; *c*, the obturator vessels; *d*, the epigastric vessels.—St. George's Hospital Museum, Ser. ix. No. 84a.



FIG. 335. A specimen of femoral hernia in which the obturator vessels are given off from the epigastric and encircle the neck of the sac. *a* shows the artery curving over the inner side of the sac, and just above the letter *a* a dark space is seen, which is an extension from the wound of the operation. *c* shows the edge of Gimbernat's ligament. The vein (cut short) is marked by the letter *b*.—St. George's Hospital Museum, Ser. ix. No. 84.

at the time of the operation ; but this was suppressed by pressure. A good deal of omentum which was in the sac was left in the wound. Sloughing attacked the wound, and then arterial hæmorrhage took place, the source of which could not be discovered. It recurred two or three times, and proved fatal. The vein and artery were both found open, the opening in the artery being a minute puncture, into which a bristle could just be passed. As it is impossible to ascertain the existence of this anomaly, the only security against injuring the vessels is to make the incision as small as is consistent with the easy reduction of the hernia.¹ If the artery has been wounded the surgeon may possibly succeed in securing it, either by seizing its mouth and tying it, as some operators have claimed to have done, or by thrusting a curved needle under the tissues in which the bleeding vessel lies and passing a ligature around them, needle and all, as in one of the forms of acupressure, or possibly by the method of 'uncipression' recommended by Vanzetti (see p. 109). The reader will find in vol. xi. of the 'Clinical Society's Transactions' an interesting paper by Mr. Barker, containing the history of a case of his own and a *résumé* of the recorded cases of this accident, with a discussion on the treatment. Cases of spontaneous recovery after a supposed wound of the obturator artery have, no doubt, occurred. Still, I think few surgeons would doubt that if an artery of considerable size has been wounded in this situation, the operator ought to do all in his power to secure it in some way.

Femoral hernia is not always easy of diagnosis. Enlarged glands sometimes lie in the crural canal, and exactly simulate a small hernial tumour, the impulse in which is absent or obscure. In fact, so close is the resemblance that exploratory operations are frequently performed. And a small hernial sac may be found lying behind an enlarged gland. The diagnosis is best made by the greater mobility of the gland, its being isolable from the underlying parts, its having no impulse when separated from the abdominal muscles, and its owning some cause, such as a sore in the lower limb, buttock, anus, or parts of generation.

Diagnosis
of femoral
hernia.

Varix of the saphena vein has been mistaken for hernia, but is distinguishable by the fact that after reduction of the tumour—which may be accomplished easily in the recumbent posture—pressure on the ring, which would keep the hernia back, will cause the varix to reappear.

Psoas abscess has been mistaken for hernia, and has often a very perceptible impulse. But the fulness in the iliac fossa which always can be detected by careful examination in psoas abscess would alone be sufficient for diagnosis ; besides, a strict examination will show that the region of the crural ring is natural, the swelling being at a point below this on the inside of the thigh, and being also perceptible on its outer side. Some very rare cases of hernia, however, have been recorded in which a hernia has descended on the outside of the femoral artery.

A cyst has sometimes been found to lie in the crural ring, which must be distinguished from hernia by the same signs as an enlarged gland.

The tumour in femoral hernia is usually small, though cases are met with in which it is of large size ; it generally turns upwards after reaching the saphenous opening, and requires to be drawn somewhat downwards before the true position of its neck is seen. Immediate attention should be given

¹ It is desirable on every ground to make the incision into the neck of the sac as small as possible, for if the neck of sac be too much enlarged it is very difficult to apply a truss satisfactorily.

to it, and it should be kept rigidly reduced, since its strangulation is very often irremediable except by operation.

The operation is exactly the same in principle as that for inguinal hernia, only that here the crural ring and the edge of Gimbernat's ligament are the points towards which the surgeon aims. An incision is made over the long axis of the tumour, somewhat internal to its middle, and the parts are divided until the sac is exposed. Then a director may be passed under Gimbernat's ligament (or any other constricting tissue that can be felt), as recommended by Mr. Gay,¹ and the extraperitoneal operation attempted. If this does not succeed the sac is to be opened.

Umbilical hernia.

The only other form of hernia which is of very common occurrence is the umbilical. This occurs constantly as a congenital affection, the bowel protruding through the unclosed navel. And there can be no doubt, from the rarity of the affection in the adult as compared with its extreme frequency in the infant, that this congenital umbilical hernia tends to spontaneous cure. Nevertheless, it should not be neglected, especially when large. The bowel should be kept reduced by means of a well-fitting pad which covers the whole ring, and which is kept accurately applied to the belly by being let into a laced belt with indiarubber sides. If this apparatus is too costly some extempore substitute can be easily devised. Careful attention for a few months is almost sure to be followed by the disappearance of the swelling.

The acquired form of umbilical hernia is generally caused by the distension of the abdominal parietes, as a consequence of obesity, repeated pregnancy, or both. The subjects of strangulation in this form of hernia are often fat elderly women who have had the disease for a long time and neglected it. The ring is often of very large size, the sac almost always contains omentum, and frequently large intestine as well as small. The hernia is covered only by the skin and expanded linea alba, and its orifice is often not the navel itself, but some weakened part of the neighbouring linea alba. Often in this hernia the symptoms which are described as strangulation are rather those of obstruction; and constipation with vomiting may continue for several days, and yet be susceptible of ultimate relief by rest, enemata, and the administration of calomel and opium. The hernia is very probably irreducible, the sac being coated internally with omentum (for in this hernia the 'omental sac' is very common), and the symptoms are rather due to the entanglement of distended bowel in the folds of this omentum than to strangulation by any definite band. The obstruction may subside on the subsidence of distension; and the results of operations on these irreducible herniæ containing large quantities of omentum are so unfavourable that it is prudent to avoid them if possible. The amount of pain and fever (in other words, the acuteness of the symptoms) is the test of the necessity for an operation. If the tumour is very tense, the pulse quick and irritable, the tongue dry, and the patient complaining greatly of pain in the tumour and the belly, the operation should not be delayed, especially if the vomit be inclining to the fecal character.

The tumour is to be freely laid open in the vertical direction, the contained bowel and omentum unravelled, and the finger passed beneath the ring to feel for the point of stricture. This being divided, the bowel should be first reduced, and the omentum then dealt with as seems advisable. All the precautions which are taken in other abdominal operations in order to

¹ See Mr. Gay's work on 'Femoral Hernia.'

avoid putrefaction should be adopted also in that for umbilical hernia; and it seems advisable to sew up the ring with catgut sutures after having returned the hernia, and to remove the sac and all the thinned skin which covers it.¹

It is only in rare cases that an operation for the radical cure of an umbilical hernia is justifiable, apart from the contingency of strangulation. In some few cases, however, chiefly when the disease occurs in young and healthy adults, who are thereby disqualified for military service or other active exertion, and in children where there is unusual difficulty in keeping up the rupture, the operation is justifiable. It is usually performed on the 'open' method, the tumour being removed, after the neck of the sac has been closed with a stout ligature and the edges of the ring sewed up. Mr. Wood² refers to five cases in which he has operated subcutaneously. Four of these were operated on by passing a wire ligature round the hernial opening and drawing it tight, like the subcutaneous ligature of a nævus. All were successful. In the other case, when quadrangular interlocked pins were used, the operation failed. These subcutaneous operations, however, seem hardly applicable to the many cases in which adherent omentum appears to constitute the difficulty in the treatment.

Radical
cure of
umbilical
hernia.

I have seen a case in which the symptoms which were referred to an umbilical hernia turned out after death to have been due to strangulation of the bowel internal to the peritoneum, and fairly within reach of the operator. Remembering this case, and that under Mr. Bryant's care, cited in 'Med.-Chir. Trans.' vol. 1. p. 65, it would be advisable, if no strangulation is found in the hernial sac, to pass the finger into the peritoneal cavity in order to ascertain whether there is any internal constriction.

Of the rarer forms of hernia the obturator, though not the most frequent, is that which presents most surgical interest, since it has in late years been made the subject of successful diagnosis and treatment.³

Obturator
hernia.

Fig. 336, from a case which occurred at St. George's Hospital before the successful treatment of this disease was known, will well illustrate its main features. The small sac (*a*) of the obturator hernia is seen lying at the upper and outer part of the thyroid foramen, almost vertically below the femoral ring, and there is a small empty hernial sac also in the external inguinal ring (*d*). Mr. Birkett has collected twenty-five cases of strangulated obturator hernia,⁴ from which it appears that this variety of hernia when strangulated may be distinguished from inguinal hernia by finding the inguinal rings and canals empty, and from femoral by the empty condition of the femoral ring, by the fulness of the 'femoral fossa' (by which term is intended the flat surface of the thigh, just below Poupart's ligament, the floor of which is formed by the pectineus muscle), by the fact that the femoral vessels lie in front of the tumour instead of outside it, by the position of the neck of the sac if perceptible below the ramus of the pubes, and by pain, which is often present in the course of the obturator nerve. But the

¹ See Reverdin in 'Revue Médicale de la Suisse Romande,' Jan. 15, 1882; Rushton Parker, op. cit.; Lucas, 'Clin. Soc. Trans.' vol. xix. p. 5. In a case of my own I pared the edges of the ring and sewed them together with silver sutures, with a most satisfactory result.

² 'Brit. Med. Journal,' June 27, 1885.

³ This very satisfactory advance in operative surgery was due, not to a hospital surgeon, but to the late Mr. Obré of Paddington.—'Med.-Chir. Trans.' vol. xxxiv.

⁴ 'Syst. of Surg.' 3rd ed. vol. ii. p. 826.

diagnosis is often very difficult, and in many of the recorded cases (as in that here figured) other forms of hernia have been present and have complicated the case. In some, it is said, no tumour has been found, and such cases could not be distinguished from instances of internal strangulation. But whenever the symptoms of strangulation are present, with no tumour in the situation of the umbilical, inguinal, or femoral herniæ (or if such herniæ though present are completely reducible), the femoral fossæ on the two sides should be carefully examined both by palpation and sight, and if any fulness on one side be observed as compared with the other, it will be justifiable to perform an exploratory operation, for which there is still more encouragement if the characteristic pain in the course of the nerve is present. The incision should be made as for femoral hernia, but should be extended further downwards, so as to have a very free opening, lying to the inside of and well away from the femoral vessels. The pectineus muscle, being exposed, is to be freely divided in the course of the skin-wound and the sac searched for and opened. It may be even necessary to separate or to divide some of the fibres of the obturator externus muscle before the sac is reached, but the surgeon should not desist from his search until the obturator foramen is clearly exposed. The position of the vessels and nerve with regard to the sac being variable, this search must be conducted carefully. If the hernia be recognised while reducible (and Mr. Kingdon has made the diagnosis no less than five times) the surgeon must explain the nature of the case to the truss-maker, and must see that the pressure acts in the right spot, and is directed backwards and somewhat upwards below the ramus of the pubes.

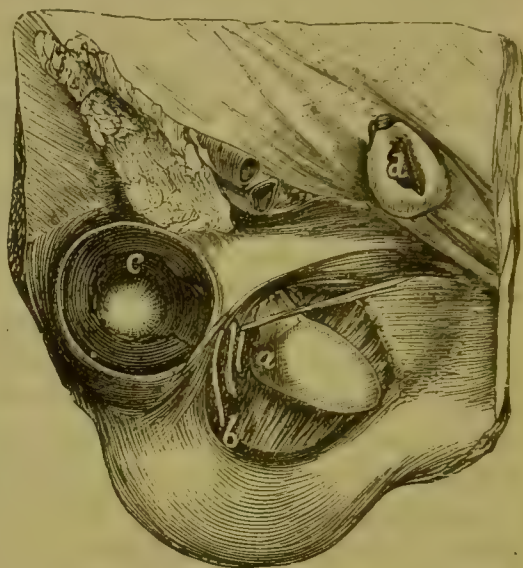


FIG. 336. Obturator hernia in a female, æt. sixty-seven, who died in St. George's Hospital, in the year 1846, from the strangulation of this hernia. She had also a small inguinal hernia, but the sac appeared to be empty. An exploratory operation was performed, and proved that this was the case. In the preparation the small sac is seen opened outside the external abdominal ring, and with a bristle placed in it (d). Below the femoral vessels and horizontal ramus of the pubes the sac of the obturator hernia (a) is seen unopened, projecting from the outer margin of the thyroid foramen, and having the nerve and vessels (b) on its outer side. It contained a small knuckle of intestine, comprising only part of the calibre of the bowel, tightly strangulated. 'c' shows the acetabulum. —St. George's Hospital Museum, Ser. ix. No. 90.

Ventral
hernia.

Hernia occurs also at any part of the belly which has been weakened by a cut, or by accidental rupture of a part of the muscular fibres, or an abscess, or possibly by over-distension. To such herniæ the name of 'ventral'² is given. The protrusions which follow on ovariectomy or ligature of the iliac arteries are familiar examples. Such hernial sacs have no neck, and are very little liable to strangulation. When the patient stands up or coughs they form large bulging tumours, in which the bowels can be plainly felt. Reduction

¹ The hernia usually contains a portion of small intestine. A case is reported in the 'Annali Univ.' Feb. 1877, by Dr. Zoja, in which the bladder partly protruded through the obturator foramen—a condition which seems to have been known or suspected by some of the old anatomists.

² Some of these herniæ when lying between the cartilages of the false ribs and the navel are called 'epigastric.'

is perfectly easy, and the wearing of an appropriate bandage, so as to keep the hernia completely reduced, is all that is necessary, as far as I have seen.

Phrenic or diaphragmatic hernia occurs as a congenital defect, a portion of the diaphragm, usually the left leaflet, being deficient, whereby the pleural and peritoneal cavities communicate quite freely, and the stomach, the transverse colon with its omentum, or other viscera, are allowed to pass freely into the thorax. It is surprising that this extensive malformation should produce no definite symptoms. I have more than once found it in the bodies of adult persons who died from other causes and had never been known to make any complaint connected with the hernia.

Phrenic
hernia.

But in other cases the diaphragm has been ruptured in consequence of severe contusion, or has been lacerated by direct wound. When phrenic hernia occurs after injury it is generally a consequence of the free rupture of the muscle from contusion, which, like the congenital defect, takes place usually on the left side. The stomach and transverse colon are, therefore, the viscera which usually protrude in this form also, and the accident may possibly be diagnosed by the greater fulness and unnatural resonance of that side of the chest, the sickness, and the symptoms of obstruction which follow it. As the accident is almost inevitably fatal, either from pleurisy or from strangulation, the question of cutting freely into the abdomen and endeavouring to reduce the viscera from below has been mooted; but no case has as yet occurred in which the diagnosis has been made clearly enough to justify the surgeon in this hazardous attempt, and the record which we now possess of cases in which the patient has survived for a considerable length of time would still further indispose any prudent person from making such an attempt. Mr. Le Gros Clark has related and figured a most interesting case, in which the patient lived more than two years after an accident in which there seemed good reason to believe that the diaphragm had been lacerated, and in whom after death the usual conditions of phrenic hernia, no doubt, existed. The only ambiguity about this case is the remote possibility that the deficiency of the diaphragm might have been congenital.¹

Sometimes one of the layers of the mesentery, or of one of the mesocolons, or of the broad ligament is dilated into a hernial sac, in which the bowel may be strangulated. Several such cases are recorded; but as the symptoms are indistinguishable from those of other forms of internal strangulation, I need not say more about these internal herniæ in this place.²

Recto-peri-
toneal
hernia.

The other rarer forms of hernia occur chiefly in the vagina or female perinæum. Vaginal hernia is not, I think, on the whole so rare as is supposed. It occurs as a congenital defect or as a consequence of stretching of the vaginal walls in parturition. The diagnosis is generally very easy. In a congenital case I ventured upon an operation to close the ring, which appeared successful.³ In the adult I have never seen any inconvenience, but it has been observed that in some cases the urinary bladder protrudes—an affection, however, which should be distinguished from hernia, under the name of *vaginal cystocele*. The intestinal hernia only requires support by an appropriate form of pessary. The vaginal cystocele may require to be operated on by removing a limited

Vaginal
hernia.

¹ Lectures on the 'Principles of Surgical Diagnosis,' p. 258.

² I would refer to a paper by Mr. Eve on a case of strangulated hernia into the fossa intersigmoidea. 'Brit. Med. Journ.' June 13, 1885.

³ Holmes's 'Surg. Dis. of Children,' 2nd ed. p. 560.

portion of the vaginal wall and sewing up the edges after having reduced the prolapsed bladder.

Perinæal,
pudendal,
ischiatric,
and lumbar
herniæ.

In perinæal hernia the recto-vaginal pouch of peritoneum is thrust out between the vagina and rectum, forming a hernial sac with small intestine in it; and I have seen the same thing occur into the rectum itself. Cases rarely occur in which the male perinæum is similarly pushed out. These herniæ merely require reduction and proper support.

Of a similar nature are the pudendal hernia, in which the neck of the sac lies between the ascending ramus of the ischium and the vagina, and the sac itself protrudes into the posterior part of the labium; the ischiatic hernia, where the gut protrudes beneath the glutæus maximus muscle, and the neck of the sac lies either above or below the pyriformis; and the lumbar hernia, in which the bowel makes its way between the quadratus lumborum and external oblique muscle.

In all these forms of hernia the main point is their diagnosis, and in all such swellings around the female parts of generation this is a matter to which much care should be given; but space fails me to enumerate the exact points of distinction between such herniæ and the abscesses, cysts, or other formations which may be met with in each region, nor is it perhaps necessary. A surgeon who is well acquainted with the principles of diagnosis and pays proper attention to his patient will be in little danger of mistaking a lumbar hernia for an abscess or a vaginal hernia for a cyst.

As to treatment, I am not aware that any of these forms of hernia have required kelotomy; but if they should, the operation would present no special difficulties, except, perhaps, in sciatic hernia, in which a large incision would have to be made, and care taken to ascertain if possible the position of the gluteal or sciatic vessels in relation to the neck of the sac. Sir A. Cooper directs that in such a contingency the incision into the neck of the sac be made directly upwards.

CHAPTER XXXIII.

DISEASES OF THE RECTUM.

HÆMORRHOIDS, or piles, are divided into external and internal, and the division is a useful and natural one ; though there are many examples of piles in which both the mucous membrane of the bowel and the skin external to the anus form a part of the covering of the tumour, and which, therefore, are partly external and partly internal. Both kinds of piles are formed of enlarged vessels surrounded by infiltrated cellular tissue. External piles consist internally of an enlarged vein or veins, partly occupied by clot, and externally of skin and connective tissue more or less thickened and inflamed. They owe their origin to any cause which determines the blood to the part or prevents its return. Pregnancy, obstruction to the portal circulation, too luxurious habits, and sedentary employments are well-known causes of external piles, and they are very commonly increased by any accidental attack of constipation. These external piles are liable to inflammation, when they become distended, livid, and intensely painful.

Hæmorrhoids.

External piles.

In cases of external piles there are generally also folds of loose integument about the anus in which no enlarged vessels can be detected, nor does the skin or cellular tissue appear indurated.

The treatment of external piles consists in the removal or palliation of their cause and the application of sedative and astringent lotions or ointments, and this is quite sufficient in the great majority of cases. When habitual constipation exists it must be relieved, and the bowels kept rather loose, by some mild laxative, for purging is by no means desirable. The confections have obtained an extensive reputation for this purpose, especially the Conf. Sennæ c̄ Sulphure and the Conf. Piperis Nigri. All improper habits, whether of diet, exercise, or anything else that can promote irritation about the pelvic organs, should be given up, and the patient should be encouraged to take gentle but regular exercise.

Treatment of external piles.

When the piles are inflamed, if the inflammation is mild, leeching is often serviceable ; if severe, the tumour should be cut across with a lancet and the blood squeezed out of the mouth of the vein, for an imperfect clot might keep the mouth of the vessel open and encourage bleeding. Also, when old piles have become much indurated and are liable to constant attacks of irritation, it is better to snip them off, and along with them to remove any loose folds of skin. But in doing this care should be taken not to cut into the anus so as to implicate the mucous membrane in this incision. Negligence in this respect has been followed by very troublesome contraction of the orifice of the anus.

Internal hæmorrhoids are produced by causes similar to those of the external variety, but they constitute a far more formidable malady. They produce bleeding, which in the worst cases is constant, though greater during defæcation, and which so exhausts the patient as to drain him of all strength and colour and leave him waxy in complexion, exhausted, languid, and unable to make any continuous effort. The piles may also cause pain and straining in defæcation ; and if the tumours are large they may protrude even

Internal piles.

when the bowels are not acting, and sometimes drag the whole end of the gut out of the anus—prolapsus. They are generally situated close to the anus, and often are partly external as well—i.e. part of them is covered by skin—but sometimes they are seated at a little distance up the bowel, and hence the necessity of having the bowel well protruded in examinations for piles. The structure of internal piles is less uniform than that of the external variety. Some consist chiefly of varicose veins, with more or less condensed cellular tissue; in some the mucous membrane is also hypertrophied; while in others the hypertrophy of the mucous membrane and its capillaries seems to constitute the bulk, if not the whole, of the tumour; in others, again, there are large arteries intermingled with the enlarged veins or capillaries and with the hypertrophied mucous membrane. The form also of these tumours varies equally. Some of them are sessile and bright red like a strawberry, while others are pendulous and livid: the arterial vessels or enlarged capillaries predominating in the former, the venous in the latter; while in piles which have long been irritated and inflamed the bulk of the tumour will be formed of condensed cellular tissue, there will be little trace of vascularity in its appearance, and its consistence will be harder.

Treatment
of internal
piles.

The treatment of internal piles must vary according to their extent, appearance, and form. When only recent, and of no great size, they may usually be relieved as external piles may, by removing or palliating their causes, and by similar treatment—i.e. gentle purgatives or laxatives—unloading the liver, and astringent applications, as the Ung. Gallæ Co., to the tumours when protruded, or astringent injections in small quantity after the bowels have acted. Douching the parts with cold water and injecting a few ounces into the rectum after each motion is often very useful in these cases; and the patient should be instructed to assume the recumbent position, with the pelvis slightly raised, for ten minutes or a quarter of an hour after defæcation. In fact, it is a good plan for him to educate his bowels to act last thing before retiring to rest, so that he may at once lie down and prevent the effects of gravitation on the dilated vessels. He ought to be instructed always to return the piles, when protruded, by gentle pressure. The constriction of the sphincter on the protruded piles produces much pain and congestion in the tumours. Sometimes, it is true, this proves curative, the whole tumour sloughing as if the sphincter acted as a sort of natural ligature; but this is too rare and too uncertain to be counted on. Far more commonly the congestion increases the bleeding and causes painful inflammation.

In cases where the bleeding is considerable or the other symptoms are urgent some steps must be taken to remove the piles. The least painful and dangerous is the application of strong nitric acid to the whole of the surface, under which it will shrivel up—possibly the superficial part of the mucous membrane will exfoliate—and thus a cure be obtained. No doubt, for those piles which are of the sessile and capillary variety, such treatment is often very efficacious, at least for the time. It not unfrequently happens that the symptoms recur, but in that case the treatment can be repeated. It causes usually but little pain, and is attended with no danger; at least, I have never seen or heard of any harm from it. But it is not likely to succeed in tumours of large size, and in those which are pendulous or hardened from inflammation it is useless. As these three classes form the majority of piles which require operation, it follows that the treatment by nitric acid is not very frequently serviceable.

There are two chief plans of operating for piles, viz. with the ligature and with the clamp and cautery. Whichever plan is adopted, the operation should be commenced by paralysing the sphincter by forcible traction or by subcutaneous division. The former procedure is effected by introducing the two thumbs into the anus and forcibly stretching the sphincter by separating the thumbs until it is completely relaxed; the latter is effected by introducing a tenotome through the skin, about a line from the anal margin, and carrying it up between the mucous membrane and the muscle till beyond its upper margin, and then cutting outwards. By either of these methods the sphincter is entirely paralysed and the anal orifice so dilated that the lower two or three inches of the bowel can be thoroughly explored and the operation of removal of the piles much more perfectly effected. This proceeding possesses the further advantage that it entirely prevents spasm of the sphincter after the operation, and so considerably minimises the after-pain. If the operation proposed is that of ligature, each pile is drawn out in succession with the forceps, any skin which is covering it is turned off the hæmorrhoidal tumour with a knife or scissors, its base transfixed with a stout double silk ligature if large, or encircled in a ligature if smaller, and the ligature tied as tightly as possible and cut short. Some surgeons puncture the pile, or cut away its superficial part; but this is unnecessary. When all the piles have

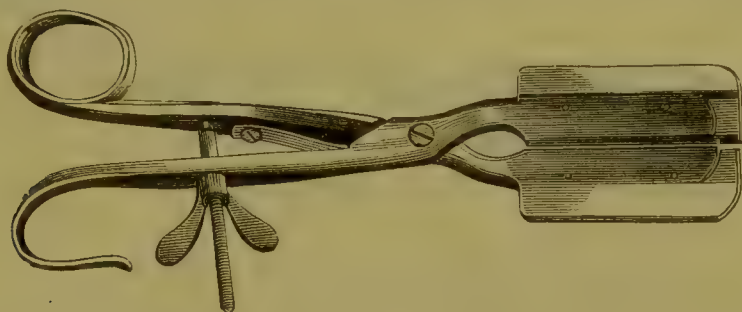


FIG. 337. Mr. H. Smith's clamp for piles.

thus been tied the mass is returned into the bowel. In operating with the cautery, each pile is, as before, successively drawn out and then a clamp is applied to its base. The clamp should have its lower surface coated with ivory, so that the heat applied to its upper part may not burn the skin. If the pile is only small its whole tissue may be seared down nearly to the level of the clamp by the cautery, or this may be done without any clamp; but it is generally necessary to cut off the pile a short distance above the clamp and then sear the base of it till a thick eschar is formed. Mr. Bryant says that for this purpose the galvanic is better than the actual cautery, as forming a thicker eschar. It has the advantage that the supply of heat is continuous, and the disadvantage that the surface of the cautery is not so large. A heat a little below white heat is safest, because it chars the tissues more slowly—if burnt too rapidly the eschar may stick to the cautery and be pulled away, causing bleeding. When the surgeon thinks the part sufficiently seared he cautiously relaxes the screw of the clamp, and if any point still bleeds repeats the cauterisation. When all is safe and every pile has been treated in this manner the whole is returned into the bowel with all possible gentleness.

The operation by the cautery is the more recent of these two plans, and is the one now in greater use,¹ and it has some incontestable advantages over

¹ Perhaps this is true rather of hospital than private practice. Mr. Curling, in the last edition of his work on 'Diseases of the Rectum,' 1876, p. 64, says, 'I continue to

the ligature—the recovery is more rapid, there is less need of confinement to bed, and it is less painful than the ligature. Against these advantages is to be set the risk of secondary hæmorrhage—which, however, is not very great—and the somewhat terrifying nature of the proceeding, if from any cause anæsthetics are not used. As to danger, though very confident opinions were expressed of the greater safety of the cautery, further experience has shown their incorrectness. Pyæmia follows operations for piles, in consequence of inflammation of the divided veins. This is very rare in any form of operation, but seems to occur quite as often after the cautery as the ligature. Tetanus has been known to occur after ligature, but it is a very rare event indeed.

Bloodless
operations
for piles.

The plan of removing piles by simply crushing the base with a clamp has lately been introduced by Mr. Pollock,¹ and possesses certain advantages. After the sphincter has been dilated the pile is seized with a pair of forceps and drawn out, and its base encircled with some form of clamp and equally and severely contused. The remnant of the pile is then cut off or allowed to

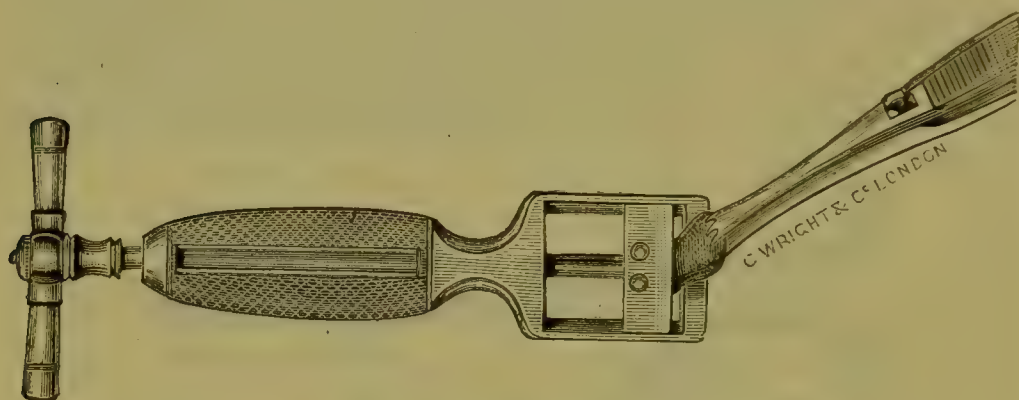


FIG. 338. Allingham's screw crushing-instrument for piles, modified.

with away. Two different forms of instrument have been invented for this operation, of which the one introduced by Mr. Allingham (and of which a slightly modified form is shown in the figure) is by far the better, since by means of its screw action it possesses more force than the lever action of the other instrument; and also, on account of its shape, it can be introduced more completely into the rectum, and thus effects a more perfect removal of the pile. The advantage which is claimed for this operation is, that as no wounded surface is exposed there is no risk of phlebitis or pyæmia; for which reason it is chiefly to be recommended in patients of broken constitution, or those labouring under known visceral disease, when it is judged expedient to operate on such patients. The immunity from danger is, however, more fancied than real. I have in my own practice had a death from pyæmia after operating on a case of piles by this method. The disadvantage of the operation is the greater liability to hæmorrhage than after the ligature, sometimes necessitating plugging the rectum or the application of perchloride of iron; so that the proceeding is not so applicable in private practice, when the patient must necessarily be left after the operation, as in hospital practice.

Mr. Reeves has described in the 'Lancet,' vol. i. 1877, p. 229, a method of treating internal piles by which he believes the cure is more rapid, more permanent, and more safe than by any other operation. The piles, being well protruded, are punctured with a sharp point attached to Paquelin's give the preference to the ligature, as more convenient to the surgeon and less alarming to the patient.

¹ 'Lancet,' July 3, 1880.

Gas-cautery raised to a dull red heat. The cautery is then rotated and gently withdrawn so as not to cause bleeding. According to the size of the pile one puncture, two, or three may be required. After all the piles have been thus treated they are returned, and a half-grain morphia suppository introduced. The bowels are kept confined for about four days, and then an injection is given. The cure, according to Mr. Reeves, is usually complete in a week, and ample experience has convinced him that relapse seldom or never occurs.

The old plan of excising the hæmorrhoidal tumours has recently been reintroduced by Mr. Whitehead of Manchester. He paralyses the sphincter by digital stretching and then divides the mucous membrane from the skin round the entire circumference of the bowel, and rapidly dissects up the mucous membrane and attached hæmorrhoids from the sphincter muscles. The mucous membrane above the piles is now divided transversely in successive stages, and the free margin of the severed membrane above is attached, as soon as divided, to the free margin of the skin below by a suitable number of sutures. By this means the whole of the pile-bearing area of mucous membrane is entirely removed, and, according to Mr. Whitehead, 'recurrence is impossible.' At all events, this gentleman has operated on more than 300 patients, and to the 'best of his knowledge every patient has been completely and permanently cured.'¹

By prolapsus ani is meant the inversion of the lower part of the bowel, and its protrusion in the form of a ring of red tumid membrane. In slighter cases this ring consists of the mucous membrane only, but in the more formidable examples the whole bowel protrudes, and sometimes for several inches. Its causes are constitutional and local. Thus, in cachectic children with relaxed fibre, any intestinal irritation, such as worms, will produce prolapsus; and in the healthiest persons, whether children or adults, prolapsus may be caused by any cause of straining, as stone, stricture, or enlarged prostate. Mr. H. Smith also says, with indisputable truth, that 'the pernicious plan of frequently using copious enemata is very constantly productive of the disorder.' The first thing, then, is to ascertain the cause, and, if this can be removed, the prolapsus, if moderate, will soon disappear with a little attention. When the general health is at fault the appropriate treatment must be employed. In childhood ferruginous tonics are commonly needed, and if the complaint depends on the irritation of worms this must be remedied. In this way most cases of prolapsus will be cured if the protruded bowel be always at once carefully reduced (which is generally easily done by pressing it gently up with the flat of the hand) and supported by a T-bandage. If very large the protruded mucous membrane is to be pencilled over with nitrate of silver in stick or smeared with nitric acid. For the cases which resist such measures (which will be very few, and chiefly inveterate cases in the adult) an operation similar to that for piles must be performed, portions of the inverted gut being tied at opposite parts of the circumference of the bowel, so that the resulting cicatrisation may keep the gut in; or, if the anus be very much stretched, lunated pieces of the skin and bowel may be removed with the scissors, and the edges of each wound stitched together; or similar portions of the skin and bowel may be clamped, cut off, and seared, just as in the operation for piles. And in fact the combination of prolapsus with piles is very common, as stated above.

Prolapsus
ani.

¹ 'Brit. Med. Journal,' Feb. 26, 1887, p. 449.

Fistula in
ano.

A fistula in ano is a channel or sinus leading by the side of the rectum, and having usually two openings (complete fistula), the upper one in the bowel, and the lower on the skin. The upper opening is generally very near the anus, and the lower is also generally not far from the margin of the orifice, so that the fistula is usually of no great length. But many exceptions occur in both respects. The sinus may open a long way up the gut, and the external orifice may be a very long way from the anus; and, again, there are fistulæ which pursue a curved course, coasting round the bowel as they pass upwards, so that the opening in the gut is on the opposite side from that on the skin ('horse-shoe fistulæ'); or a single opening in the bowel may communicate with two or more orifices on the skin ('Y-shaped fistulæ'). Inattention to these peculiarities may cause a surgeon to overlook the internal orifice in cases of complete fistula. But there is no doubt that incomplete fistulæ also exist, and that of two kinds—blind external fistula (Fig. 339), in which there is a sinus leading up along the bowel, but no internal opening; and blind internal fistula, where there is an opening in the bowel, leading down into the cellular tissue, but no orifice in the skin.



FIG. 339. *Fistulæ in ano, without any internal opening*. There are two fistulous openings, into which bougies have been inserted, and which run for some distance in the cellular tissue, terminating beneath the wall of the bowel. At *a* is an elliptical depression which has every appearance of being the original orifice of one (perhaps of both) of the fistulæ, but is now soundly healed.—Museum of St. George's Hospital, Ser. ix. No. 45.

Fistula originates in two ways, viz. either as an ulcerated opening in the wall of the bowel, the matter from which makes its way down along the gut to open externally, or as an abscess in the cellular tissue which bursts at one end into the bowel and at the other through the skin. It is obvious that either of these actions may be so modified as to give rise to incomplete fistula. Thus, if the matter from the ulcerated opening in the bowel does not make its way through the skin, but after gravitating or 'pocketing' down towards the anus continues to discharge into the bowel, we have the incomplete internal fistula. If the abscess outside the bowel makes its way through the skin, but does not burst into the gut, or if in a complete fistula the internal opening should close (as in Fig. 339), we have the blind external fistula.

The causes of the ulceration of the bowel which leads to fistula are not always easy to trace. It is customary to speak of foreign bodies, such as a fishbone, passing through the whole intestinal tract, and then irritating or lacerating the rectum, being detained there by the sphincter, and certainly I once saw a case in which a fishbone was found in a fistula; but such cases are mere curiosities. It is quite possible, however, that either foreign bodies or hardened feces may irritate this or any other part of the mucous membrane and cause ulceration, and of course this part would be far more exposed to such irritation than any other. In many cases the ulceration seems to be due to the strumous cachexia, and fistula is a well-known complication of phthisis.

Ischio-
rectal
abscess.

The frequent connection between abscess near the anus and fistula renders the surgeon always anxious to open such abscesses early and very freely, in order to avoid any denudation of the wall of the gut and consequent perforation. The abscess is to be punctured, a director passed into the puncture, and the whole cavity laid open as far as its extremity on either side. If this is early done fistula hardly ever follows.

In examining a case of fistula the first care of the surgeon is to ascertain the condition of the patient's health, and more especially whether or no there are any clear symptoms of phthisis. If the patient be undoubtedly phthisical it is often better not to operate, for the operation is frequently unsuccessful, the wound continuing unhealed up to the time of the patient's death; and the division of the fistula sometimes appears to aggravate the internal mischief, possibly by the irritation and discharge which it causes. But these objections apply chiefly to advanced stages of phthisis. If the disease in the lungs is in an early stage, and the patient is much annoyed by the consequences of the fistula, it is better to operate.

It must not be forgotten that every fistulous opening near the anus is not necessarily a fistula in ano, i.e. a sinus originating in or leading to the rectum. I have seen a labial abscess from gonorrhœa, contracted to a sinus, mistaken for a fistula in ano, and fistulous channels in connection with disease of the pelvis not very uncommonly open near the anus. Another very important caution as to the diagnosis of fistula is not to confound with simple fistulæ those fistulous openings which form in connection with stricture of the bowel. Such cases are not rare, and they are overlooked sometimes by people who ought to know better. When the stricture is simple, nothing is required for the cure of the fistula but the dilatation of the stricture, just as in perinæal fistula. When the stricture is cancerous no local treatment can do any good. In either case the incision of the fistula is a great mistake. Careful examination of the higher part of the bowel is, therefore, necessary in any case of fistula whose cause is obscure, and particularly in those which are multiple and surrounded by a good deal of indurated tissue, as the fistulæ in connection with stricture usually are.

Diagnosis.

The operation for fistula is one of the simplest possible. It consists merely in passing a director through the fistula and laying its whole track open. But it is often very difficult to find the internal opening, from the sinuous direction of the fistula, or from the small size of the opening into the bowel compared with the extent of the abscess; for the abscess often stretches to a great distance up the gut, while the internal orifice is close above the sphincter. Often the surgeon may feel the orifice as a small pimple on the wall of the bowel, and if this be on the opposite side of the gut from the external opening, he will discover it by laying open the superficial part of the sinus under chloroform and tracing it carefully step by step around the bowel. But no doubt in some cases (Fig. 339) there is no internal opening, and then the surgeon must make one by pushing the director through the wall of the bowel where it feels most thinned and exposed. Such operations, however, are unsatisfactory. If the internal opening has been overlooked the fistula will surely reproduce itself.

Treatment.

If there be no external opening the internal orifice can usually be seen or felt, and a bent probe can be hooked in it, so that its point projects under the skin. This is then cut down upon, and so the fistula is rendered complete and at once laid open.

There is no necessity for any elaborate dressing after the operation. It is

well, I think, to put a piece of oiled lint into the wound, and keep it there twenty-four or forty-eight hours, so as to avoid the agglutination of the superficial part of the wound; and afterwards to pass a probe or director down to the bottom of it, to ensure its filling up regularly; and it is a comfort for the patient if he can be spared any action of the bowels for a few days.

The other methods which have been used for the cure of fistula are the elastic ligature, the electric cautery, and the *écraseur*. They are much inferior to the cutting operation, but one or other may be used on patients who will not submit to the knife, and I should think the best would be the elastic ligature, but I have no experience of it.¹

The cause of the persistence of fistula is doubtless the action of the sphincter ani, which constantly presses upon the walls of the abscess and disturbs any attempt at union. Yet spontaneous cure, in long periods of time, is not unknown. Sir Prescott Hewett mentioned a short time ago at St. George's Hospital two cases as occurring under his own observation; but the event is too rare and the length of time required too long to afford any valid argument against the advisability of operating whenever the general health will bear it.

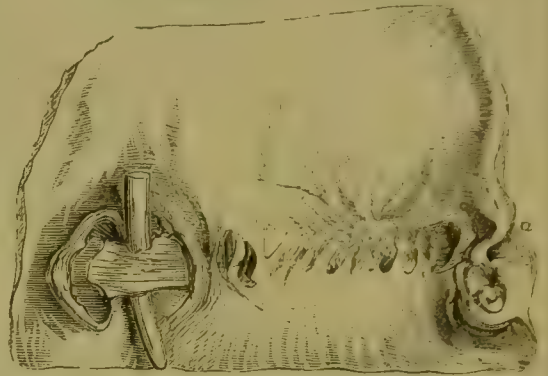


FIG. 340. Fistula in ano. The puckered part represents the anus. A bougie has been passed through the fistula, and the mucous membrane has been removed in order to show the fibres of the external sphincter, outside which the channel of the fistula extends. Below the letter *a* is seen an external pile, which has been cut across. The preparation well illustrates both the cause of the persistence of fistula and the manner in which the operation removes that cause. The director being passed in the track of the bougie above figured, the sphincter is cut completely across, and is then prevented from re-uniting till the track of the sinus below has been obliterated by cicatrization.—St. George's Hospital Museum, Ser. ix. No. 42.

Ulcer or
fissure of
the anus

Fissure, or, as it is perhaps better called, ulcer of the anus, is a very painful and distressing complaint, which, however, is usually relieved immediately by very simple treatment. It forms a little crack on the edge of the bowel, hardly implicating the whole thickness of the skin, extending, perhaps, a certain distance up the gut—say half an inch—and situated in the great majority of instances towards the coccyx. An external pile very often forms by the side of the fissure, or possibly the fissure forms at the base of the pile. The fissure is the seat of great pain, especially when the bowels act, and this pain frequently lasts for a long while after defæcation, and is often so severe that the dread of it causes the patient to avoid empty-

¹ I would refer the reader to a discussion at the Clinical Society, reported in the 'Lancet,' June 5, 1875, on an interesting case under Mr. Maunders's care of double fistula in the same patient. One was treated by incision, the other with the elastic ligature. The result showed the great superiority of the cutting operation, for the wound made with the knife united kindly and with little pain, while that produced by the elastic ligature was left with callous prominent edges, and did not unite till five weeks after the other was healed. All the surgeons who took part in the debate appeared to be unanimous in condemning the treatment by the elastic ligature as a method for general use, while admitting that it might be indicated under exceptional circumstances, chiefly when the opening is very high and the surgeon has reason to fear the effect which the necessary division of somewhat large vessels may have on his patient. The ligature has been applied by Mr. Reeves for the cure of fistula in ano in a new way. Having passed a stout twine up the fistula into the bowel, he ties it tight till the tissue included in the knot gives way, then a fresh portion is tied, and so on. The plan seems intended to obviate any danger of hæmorrhage and also to humour the prejudice of patients who will not submit to be 'cut.'—'Med. Times and Gaz.' June 15, 1878.

ing the gut as long as possible, so that sometimes a very deleterious habit of enforced constipation is set up, which greatly impairs the digestive functions. The obstacle to the healing of this ulcer lies obviously in the connection of the ulcerated skin with the sphincter ani. The cause of the fissure is not always apparent. It is more common in women than men, and may be produced by the irritation of discharges. In the majority of cases it is associated with debility or a deterioration of the general health. From some cause—overwork, anxiety, insufficient or improper food—a patient's health gets below par, and under these circumstances, if a slight crack or 'chap' of the mucous membrane occurs, perhaps from the passage of a hardened mass of fæces, it does not heal, as it would in a healthy subject, but forms an ulcer, and so 'fissure of the anus.'

Some of the milder cases of fissure are amenable to treatment by improving the general health, cleanliness, attention to the state of the bowels, so that the fæces are never hard nor the action costive, and some stimulating application, of which an ointment of grey oxide of mercury, introduced before and after defæcation, is the best. But the operation which cures the disease is so simple and affords so much immediate relief that it is seldom worth while to spend time on any other local treatment. In many cases forcible dilatation of the sphincter is all that is necessary, or this muscle may be divided subcutaneously. The operation usually recommended consists in exposing the whole extent of the ulcer with a speculum, and then making an incision through its whole length and depth with a stout straight probe-pointed bistoury. This incision should be made carefully, so as to reach the healthy tissue throughout its whole extent. This is usually quite sufficient. If it fails, the division of the entire sphincter (including, of course, the ulcer in the cut) may be necessary. If there is any growth (pile or polypus) near the fissure, it should of course be removed at the same time.

Pruritus ani is often a troublesome affection, and in some cases is so distressing and uncontrollable that, as is the case with pruritus vulvæ, it almost obliges the sufferer to renounce society. Usually, however, it is symptomatic of some disorder of the digestive or sexual organs, and if taken in time is perfectly manageable. Careful attention to the state of the bowels, the expulsion of worms, and the careful regulation of the diet, are the first requisites. It seems to me often to depend on the too free use of stimulants. The local treatment consists of astringent and sedative lotions, with scrupulous cleanliness and perhaps a narcotic at bedtime, when the itching is apt to be severe. Careful examination, however, is necessary to ascertain the absence of fissure of the anus or condylomata, of which pruritus is sometimes only a symptom. The disease is often attended with small excoriations, hardly deserving the name of fissures, around the anus, and the itching will disappear when these are brought to heal, which is usually effected by touching them with nitrate of silver and applying nitrate of silver in solution.

Pruritis
ani.

Mr. H. Smith recommends in these cases glycerine ointment—a drachm of glycerine to an ounce of lard—or an ointment composed of calomel of the same strength (ʒi. : ʒi.). The black or yellow wash is also sometimes useful, and the daily passage of a bougie will sometimes render the anus less irritable.

Polypus of the rectum is a disease which, though not confined to childhood, is most common at that period of life. Two forms of it are described—the vascular and the fibrous—but the difference is one rather of degree of

Polypus of
the rectum.

vascularity than of kind, both being formed of fibrous tissue with vessels intermixed.¹ The earlier the age is the more vascular, as a rule, will be the polypus. These polypi are often attached by long stalks to the bowel, so that when they float up into the gut they are imperceptible and cause no symptoms, but when they are carried down they are grasped by the sphincter, and this causes pain and bleeding. If a child suffers from occasional bleeding from the bowel it is usually from this cause. Piles are very rare in childhood. The polypus, however, may easily escape detection, especially if the bowels have not acted recently. The surest way to detect it is to make the bowels act by an enema, when the polypus will probably present as a small red projection at the anus, or can be felt and drawn down by sweeping the finger round the bowel. Sometimes the surgeon, in so doing, breaks it off and cures the disease, otherwise it is necessary to remove it. There is little or no danger in the less vascular specimens in twisting it off with a pair of forceps; but it is, of course, safer to tie the base and cut it off close to the ligature; and as this gives little if any pain it is the course generally adopted.



FIG. 341. Polypus of the rectum; adenoid. From a preparation in the Museum of St. George's Hospital. It grew from a slender stalk (*a*) just outside the sphincter. The patient, a young woman, made a rapid recovery after the removal of the tumour.



FIG. 342. Villous tumour of the rectum. From a preparation in the Museum of St. George's Hospital, Ser. ix. No. 336. The tumour is seen to occupy a great part of the circumference of the bowel and extended down nearly to the external sphincter. *a*, *b*, point to parts in which the mucous membrane seems to be entirely gone, exposing the muscular fibres. This might have been the effect of some of the avulsions practised during life.

Villous
tumours.

Villous disease of the rectum is a rare form of tumour, of which, however, I once saw a very striking instance,² here figured, in which the tumour used to grow to such an extent as to produce some obstruction, from which the patient was relieved by tearing away portions of the mass. This was done thirty-three

¹ In some of these polypi adenoid tissue may be detected; others consist entirely of epithelium—are, in fact, gigantic warts. A case of this sort is figured in Mr. H. Smith's essay, 'Syst. of Surg.' 3rd ed. vol. ii. p. 865.

² 'Path. Trans.' vol. xii. p. 120. The preparation is preserved in St. George's Hospital Museum, and is figured in Mr. H. Smith's essay.

times, and always with temporary relief. The patient survived five years, and died at the age of seventy. The whole course of the disease in this case, as well as the microscopic examination, showed that the tumour was of a non-malignant nature, though probably in the rectum, as in the bladder, cancerous tumours may be covered with a layer of villous processes. The diagnosis of such tumours when within the reach of the finger or hand will rest on their comparatively slow growth, the villous character of their surface, the absence of hardness at their base, and of any symptoms not explicable by their mechanical pressure.

I ought to mention here—though chiefly for the sake of diagnosis—the syphilitic affections so frequently found near the anus, viz. mucous tubercles and condylomata. Mucous tubercles are often confounded, even at the present day, with external piles. Yet the diagnosis is as easy as possible. Piles are rounded, somewhat pendulous tumours, covered with healthy skin, and only occasionally connected with any symptoms of syphilis, which on careful examination will be found to have nothing but an accidental reference to the disease. Mucous tubercles, on the contrary, form small, perfectly flat, sessile elevations, covered with a velvety or warty and moist epidermis, and are always developed in the course of a regular outbreak of secondary or (what is the same thing) congenital syphilis. I have spoken above (page 409) of the probably contagious nature of their moist secretion, and of the great efficacy of the local and general administration of mercury in their treatment.

Mucous
tubercles
and condy-
lomata.

Condylomata are generally syphilitic, though they may proceed from the irritation of gonorrhœal and possibly other discharges. They form large pedunculated masses, in which all the textures of the skin can be detected, covered with a foul warty surface and exhaling a fœtid moisture, frequently very vascular, and bleeding to an alarming extent sometimes when removed. The elastic ligature, though inferior in most situations to the knife for the removal of tumours, seems to me very appropriate for the treatment of condylomata.

Stricture of the rectum is either (1) simple, i.e. due to fibroid thickening of the walls of the bowel; (2) syphilitic; or (3) malignant. Simple stricture depends on the deposit of fibroid material in the wall of the bowel, or external to it, probably from chronic inflammation (fig. 343), or on the healing of ulcers, and these are either strumous, dysenteric, or accidental. It may arise, therefore, from long-continued diarrhœa or chronic dysentery, from tubercular ulceration (fig. 344), from pelvic inflammation following childbirth, from operations for piles, and for fistulæ. It occurs especially in old people, and particularly in women, and is usually situated at the upper part of the rectum at its junction with the sigmoid flexure of the colon.

Stricture
of rectum.

The symptoms are very insidious, and commence with difficulty in defæcation, which is probably, at first, attributed to constipation. The motions are noticed to be tape-like, or small, or to consist of scybalous masses. But it must be borne in mind that this symptom in itself is not characteristic of stricture, and oftentimes too much importance is attached to it. Too soft a condition of the fecal mass, or an irritable state of the sphincter, will produce the same appearance, but the history that the patient gives that the condition is not constant, and that occasionally the motions are well formed, will decide as to whether it is due to stricture or not. As the disease advances a spurious diarrhœa is set up, and there is a constant desire

to defæcate, the effort being attended with the passage of only a small amount of solid matter, with a quantity of yeast-like discharge, and the occasional passage of blood and mucus. Accompanying these local symptoms there is dyspepsia, and flatulency, and the patient loses flesh. At this time abscesses may form above the stricture, and may burst into the vagina or bladder, and the fæces discharge themselves into these passages, or they may pass down into the pelvis and burst into the ischio-rectal space or upon the buttock. Or complete obstruction may come on either gradually, when the patient may live several weeks after perfect occlusion has taken place; or suddenly,



FIG. 343. Simple stricture of the rectum, at a point about one inch from the anus. The surface of the mucous membrane is much ulcerated, and the walls of the bowel in this situation (which is contiguous to the uterus) are much thickened and indurated. On microscopical examination this thickening was found to be due entirely to the development of a firm fibrous material in the submucous areolar tissue, and in the cellular tissue outside the bowel. No peculiar cell-formations could be detected in this material.—Museum of St. George's Hospital, Ser. ix. No. 37.

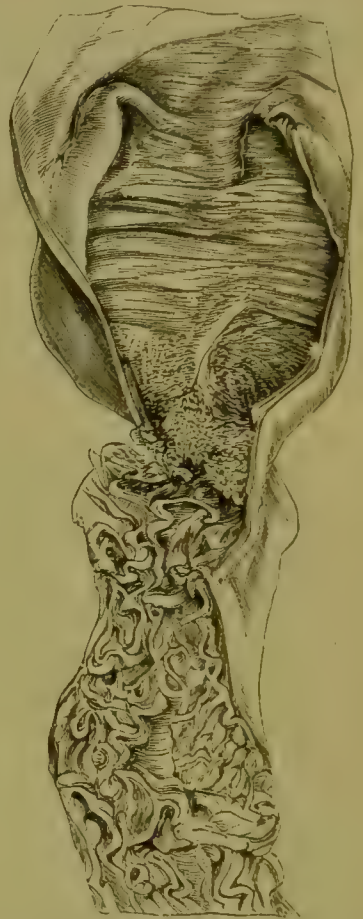


FIG. 344. Extensive ulceration and contraction of the bowel, with distension above the contracted part, due probably to tubercular ulceration.—St. George's Hospital Museum, Ser. ix. No. 49a.

with symptoms of acute obstruction. Or peritonitis may supervene and terminate the life of the patient.

The treatment of stricture of the rectum is in some cases decisive and very successful. When the obstruction is formed merely by an ulcer which has cicatrised, and the constitutional condition on which it may have depended has passed away, the health may be as completely and rapidly restored by dilating the stricture as in the parallel case of stricture of the urethra; and, as in the urethra, this dilatation may be accomplished either gradually, by means of bougies, or rapidly, by incision. The latter method is by no means free from danger. I have seen peritonitis and death follow the incision of a

stricture of the rectum even when the incision was quite away from the peritoneal cavity and strictly limited to the posterior wall of the bowel.¹ It should be reserved for dense cicatricial strictures in which the method of gradual dilatation fails or is too painful. It is accomplished by passing a director through the stricture (which is supposed to be too tight to admit the finger) and guiding a hernia-knife upon it, with which the tissue of the stricture is to be slightly notched backwards or towards the sacrum in one or two places to an extent sufficient to admit the passage of the little finger, and therefore of a small bougie. Perhaps the bistouri-caché is a safer instrument. This operation, however, is only intended as a preliminary to the use of the bougie. Although, as I have said before, it is not free from

grave risk, in appropriate cases (i.e. cases of tough cicatrix) its beneficial effects are almost magical.

Still more rapid relief is given by the total Rectotomy.² division of the stricture and of all the coats of the bowel including the external sphincter (an operation to which American surgeons have given the name of 'Rectotomy')² in cases which are appropriate for the operation. What these cases are, our experience of the operation hardly enables us to say at present. In the only case in which I have as yet employed it, it was unquestionably indicated and was rapidly successful. The patient was a woman with a very tight non-cancerous stricture, probably syphilitic, not far from the anus. It was not easy to introduce even a small director through the opening. All inconvenience disappeared and she left the hospital, apparently quite well, within a month. The hæmorrhage if considerable (which it rarely is if the incision is kept in the middle line) may be controlled by plugging the wound with ice. The wound and the bowel should be washed out by copious injections twice a day after the operation, and a full-sized bougie or the finger passed daily from about a fortnight after the incision for an unlimited time.

For slighter cases of non-cancerous stricture the rectum bougie is all that is required. It should be passed at first by the surgeon or by a skilled attendant until the stricture will freely admit an instrument the size of the middle finger and all

trouble from obstruction is over, when the patient may be instructed to pass it, and should at first be watched to see that he really does pass it through the stricture. As in the urethra, it will be necessary to keep the stricture dilated for a time which is practically unlimited.

Syphilitic stricture of the rectum occurs almost exclusively in women, usually under the age of thirty, and from this circumstance it has been believed by some that it is due to a direct extension of the disease from the vagina, but there is nothing beyond the fact above stated, and that it usually occurs close to the anal orifice, to lend support to this view. It is essentially a tertiary affec-

Syphilitic
stricture



FIG. 345. Bistouri-caché. The instrument is passed through the orifice to be incised, with the knife concealed in the stem. By pressure on the handle the blade is projected to an extent which is regulated by the screw.

¹See Curling, 'Dis. of Rectum,' 4th ed. p. 140.

²See Beane, 'Am. Journ. Med. Sci.' April, 1878.

tion, and consists in a fibroid induration of the sub-mucous tissue with ulceration of the mucous membrane. The stricture is caused by the contraction of the newly formed fibroid tissue, and usually precedes the ulceration; though later on the ulcers may heal, and then their cicatrices may produce an ordinary fibrous stricture as in the cicatrization of ulcers arising from other causes. In the earlier condition, where the stricture is due to the contraction of the newly formed fibroid tissue, there is felt to be an irregular indurated constriction of the calibre of the bowel as far as the finger can reach, and the examination causes the patient very great pain. The surface of the mucous membrane, if it can be examined, will be found to be ulcerated, and there will be a discharge of blood-stained purulent fluid. Other symptoms of syphilis will usually be present.

The treatment consists in placing the patient under constitutional treatment for syphilis and introducing bougies of cocoa-nut butter, with which a small amount of blue ointment has been incorporated, daily into the rectum. Occasionally the passage of an ordinary bougie which has been smeared with blue ointment will be found useful. If much ulceration is present, the introduction of iodoform suppositories should be resorted to, until the ulcers are healed, when the dilatation of any cicatricial tissue which may have formed may be proceeded with as in ordinary simple stricture.

Malignant
stricture
of the
rectum.

The form of cancer which almost invariably attacks the rectum is the cylindrical epithelioma. Other forms of carcinoma are described as occurring in this situation, especially scirrhus, but it is probably very rare, if, indeed, it ever occurs. Carcinoma of the rectum not unfrequently undergoes a colloid degeneration and forms a large soft mass presenting the appearance of boiled sago-grains. Melanoid sarcoma is occasionally found in this situation. Epithelioma tends to develop according to the type of the normal epithelium from which it grows; in the rectum, therefore, it is of the columnar or cylindrical variety. This is sometimes termed adenoid carcinoma, since it presents microscopically a number of tubules, lined with a single layer of cylindrical epithelium. The disease begins in the lining membrane of the bowel, but speedily invades the submucous tissue and generally spreads in this tissue, between the mucous and muscular coats; having a tendency to spread laterally rather than in the long axis of the bowel, and so to encircle the gut. At other times, however, the new growth shows a tendency to project itself into the lumen of the tube, forming a distinct fungous mass, which has somewhat of a cauliflower form, and obstructs the bowel. The mass varies much in consistency, being sometimes of almost stony hardness, at others soft and feeling almost like encephaloid. It would appear that the consistency depends upon the rate of growth. The more rapidly it grows, the softer it is.

Malignant disease of the rectum is an affection of middle life rarely occurring before the age of forty-five. It generally attacks the bowel about three inches from the anal orifice, so as to be well within reach of the finger. Sometimes, however, it commences lower down, and the finger can be introduced well above the disease and feel healthy bowel. On the other hand, occasionally the growth is beyond the reach of the finger altogether. The symptoms of malignant stricture of the rectum are in its early stage very insidious. There is perhaps some constipation and difficulty in defæcation, with a sense of uneasiness, scarcely amounting to pain, in the rectum, and frequent desire to go to stool. This may be attended with the passage of a small amount of blood-stained mucus. After a time the pain becomes severe, and is accompanied by a sensation of weight and dragging in the perinæum.

In some cases pain and cramp in the lower extremities is complained of from pressure of the growth on the sacral plexus of nerves. The calls to go to stool are constant, and the efforts at defæcation are attended with increased and often intense pain. If the bladder becomes involved, there is difficulty also in micturition.

The hæmorrhage from the bowel now becomes more profuse, and the discharge of mucus also increases and alters in character, becoming semi-purulent and very offensive. The patient will complain of diarrhœa, but in truth there is often constipation, the sufferer only getting rid of small scybalous masses of fæces after severe straining. During this time the

patient emaciates: he loses strength and weight; he is unable to sleep, and his appetite fails him. Examination of the rectum with the finger will show, when the growth can be reached, several different conditions. The most common is to find the whole of the wall of the gut occupied, from about 2 to 3 inches from the anus, as far as the finger can reach, by a hard, nodulated mass, which is roughened and ulcerated on its surface, and in the centre of which can be felt a small opening hardly admitting the finger. At other times a rugged, irregular, cauliflower excrescence will be felt protruding into and obstructing the tube and fixed to one side of the gut, with much induration around. Again, in other cases an excavated ulcerated surface may be felt with hard everted edges. In all cases the bowel will probably be felt to be more fixed to surrounding structures than in the normal condition.

The main feature in the diagnosis between simple stricture and the obstruction of cancer lies in the fact that in cancer the morbid deposit is infiltrated for a considerable distance into the walls of the bowel and the neighbouring tissues, producing a hard irregular nodulated mass which ex-



FIG. 346. Malignant deposit and ulceration of the rectum.—Museum of St. George's Hospital, Ser. ix. No. 64.

tends for some distance from the seat of obstruction (fig. 346), and also causes the bowel to become fixed to surrounding parts. It must be admitted, however, that the diagnosis is often by no means easy in some cases, especially of syphilitic ulceration, where the ulcerated and contracted surface is very extensive and the patient exhausted by suffering. The age of the patient, the history of the case, the presence of other syphilitic manifestations, and the effects of treatment will generally, however, suffice to decide upon the nature of the case. Death may occur in these cases in several different ways. Secondary growths may take place in other parts, generally the liver, and

may terminate the patient's existence. Or he may die of exhaustion, worn out by pain, continuous discharge, frequent hæmorrhage, and inability to take food. Occasionally perforation of the bowel above the stricture occurs and a fatal peritonitis ensues, and finally total occlusion may come on and rapidly destroy life.

Treatment.

The treatment of malignant stricture may be either palliative or curative. But in a large proportion of cases only the former plan of treatment is possible. The employment of gentle laxatives, to keep the motions soft, and avoid the irritation produced in the upper bowel by the detention of hardened fæces; opium or morphia, to relieve pain and procure sleep, and nourishing food in small bulk, constitute the main indications for treatment in the early stage. Recently, the belief has gained ground that, if the operation of colotomy is performed early, the removal of the constant irritation of the passage of fæces over the diseased surface causes a diminution in the rate of progress of the growth, and therefore prolongs the patient's life. The operation of colotomy has therefore become very much more common of late, and much more is known about it than was the case formerly. We now know that after successful colotomy, or indeed after the formation of an artificial anus in any part of the intestine, the patient's life is not by any means so miserable as was thought formerly to be the case; and we also know that the cancer which affects the lower bowel is frequently of the less malignant and rapidly-growing forms, and therefore that if the effects of mechanical obstruction and consequent irritation can be obviated the patient may survive a long time. Then again, the sufferings which cancer occasions, when the surface over which the fæces pass is extensively ulcerated, are often very acute, and it is worth the patient's while to submit to the risk of the operation even for that cause only, irrespective of any obstruction. For a description of the operation of lumbar colotomy see the section on Internal Strangulation (p. 670).

Inguinal colotomy.

Mr. Herbert Allingham¹ has lately advocated the performance of inguinal colotomy, instead of the lumbar operation, in cases of cancer of the rectum, and has devised an ingenious method of operating in this situation. If what has been said above is true, that the rate of growth of the tumour is retarded by preventing the passage of fæcal matter over the ulcerated surface, any operation of colotomy should be of such a nature as entirely to prevent the chance of any small amount of fæces finding its way past the artificial anus. This lumbar colotomy (Amussat's operation) does not do, and the patient is often troubled by a small scybalous mass finding its way past the opening and becoming entangled in the ulcerated surface. Mr. Allingham in his operation obviates this by drawing a loop of the sigmoid flexure out of the wound and fixing it there, and, after union has taken place, cutting it off. By this means he forms a spur-shaped process of the meso-colon, such as is seen in artificial anus after sloughing of the gut from strangulated hernia, and entirely prevents fæces finding their way into the lower opening of the bowel.

The steps of Mr. Allingham's operation are briefly as follows: He makes an incision two inches in length, from a point one inch internal to the anterior superior spinous process of the ilium parallel to Poupart's ligament. The peritoneum is opened by a small incision, and the edges of the opening are seized with clip forceps, before it is incised to the full extent of the wound with scissors. The cut edge of the peritoneum is now sewn to the margin of

¹ 'British Medical Journal,' Oct. 22, 1887, p. 874.

the wound in the skin, a flat sponge being placed over the intestine to prevent protrusion. Search is made for the sigmoid flexure, which when found is drawn out of the wound. A carbolised silk suture is passed through the mesentery in two places close to the gut, and the two ends carried through the abdominal wall, nearer the lower than the upper angle of the wound, and a second suture passed in the opposite direction through the other edge of the wound. When these are tied the loop of bowel is fixed outside the abdominal wall. The intestine is now sewn to the skin by numerous sutures passing only through the serous and muscular coats. The wound is dressed with an antiseptic dressing and the parts left for a few days. On the second to the fourth

day, or earlier if deemed necessary, the protruded coil of intestine is opened and removed with scissors.

The curative treatment of cancer of the rectum consists in excision of the strictured portion of the intestine, and this may be done in one of two ways according to the situation of the growth. When the disease is situated at the lower end of the bowel, so that the finger when introduced through the stricture can feel perfectly healthy structures beyond, the whole of the lower end of the rectum may be removed along with as much as may be necessary of the parts in the ischio-rectal fossa. The proceeding is a severe one, and by no means

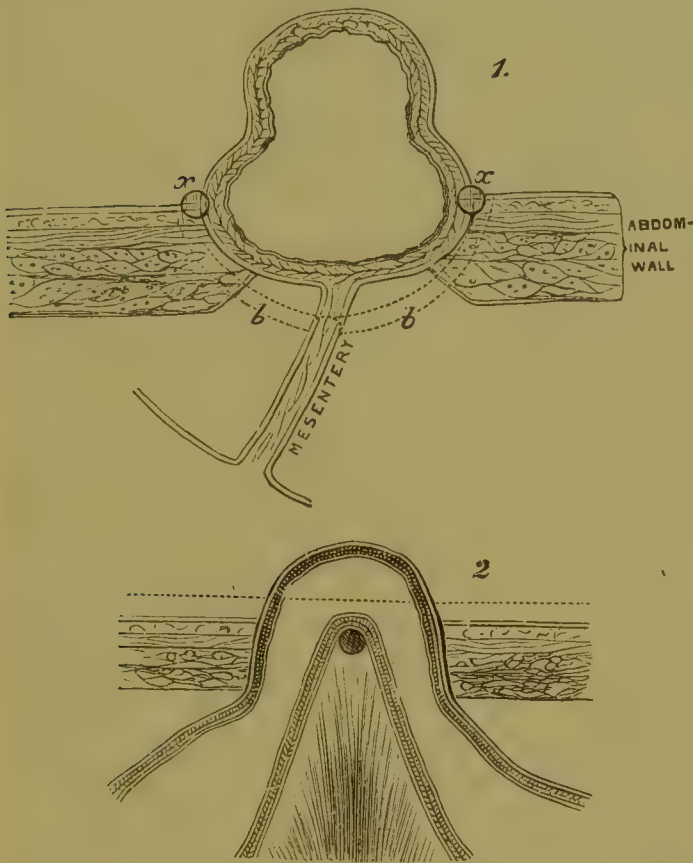


FIG. 347. Diagram showing Mr. H. Allingham's mode of performing inguinal colotomy. The upper figure shows the gut brought to the surface, and a suture of carbolised silk (*b*) passed through the mesentery and then through the abdominal wall on both sides of the wound. *x* represents the suture attaching the serous and muscular coats of the gut to the skin. The lower figure shows the two portions of intestine separated by a well-formed spur.

free from danger, and there are only a small percentage of cases in which it is applicable, as it is confined to those cases in which the disease is limited to the lower two and a half or three inches of the bowel. Moreover, it should only be performed in those cases where the gut is freely movable and the growth has not infiltrated surrounding parts, and where the patient is in fairly good health and has not been worn out by the disease. The operation is performed as follows: The patient having been placed in the lithotomy position, a deep incision is made in the middle line of the ischio-rectal fossa reaching to the coccyx, as recommended by Denonvilliers. This is best done by introducing a curved sharp-pointed bistoury, guarded by the forefinger, into the anus and carrying it just beyond the growth. The point is then made to transfix the gut behind and appear at the tip of the coccyx. By cutting outwards the whole of the tissues between the anus and coccyx are

divided. The skin is now incised with a scalpel around the orifice of the rectum, and the gut separated from the tissues of the ischio-rectal fossa. Posteriorly the separation can be performed rapidly and without difficulty by means of the finger and scissors, but in front great care will have to be observed in separating the bowel from the urethra and prostate in the male, and the vagina in the female. As the dissection is being carried on, all bleeding vessels are to be tied, twisted, or compressed by force-pressure forceps. The bowel being freed is to be gradually drawn out, till the limit of the disease is fairly reached above and at the sides. When this has been done the gut may be severed with the knife, galvanic cautery, or *écraseur*, as may be judged best. It is useless to try and bring down the bowel and fix it to the external wound, as the tension on the stitches is so great that they speedily cut their way out. The surface of the wound should be thoroughly sponged out with a strong solution of chloride of zinc, and iodoform then applied. The bowels should be kept confined for a week or ten days. As healing takes place the mucous membrane becomes drawn down, and in the majority of cases the patient acquires the power of retaining his *fæces*. In a large percentage of cases contraction takes place, requiring the daily introduction of a bougie.

The main dangers of the operation are hæmorrhage and wound of the peritoneum. Some surgeons conduct most of the deeper dissection with the *thérmo-cautery*, in order to avoid the risk of bleeding, and this may be necessary in dealing with very vascular and rapidly growing tumours; but in general the free exposure of the parts which is secured by Denonvilliers' method enables the operator to take up each vessel as it is wounded. Still the actual cautery ought to be at hand if wanted. Wounding the peritoneal cavity is a still more formidable risk. In the male sex it seems that the reflection of the peritoneum may be pushed somewhat upwards by injecting the bladder. In the female the surgeon can judge of its position by the finger in the vagina. But in both, the great security against wounding the serous membrane in the deep dissection is to draw the gut down as its attachments are divided. When the disease is confined to one side of the bowel, a portion of the circumference of the gut only needs removal, and this is a much more successful operation, and is seldom followed by contraction and stricture or incontinence of *fæces*. In some cases it may be done without the preliminary incision of Denonvilliers by simply stretching the sphincter; but if the disease is at all extensive, this incision will give a much better access to the part and allow of a much more thorough exposure of the disease, so as to insure its complete removal. It can usually easily be extirpated by cutting the healthy mucous membrane all round the disease with curved scissors and then encircling it with a wire *écraseur*, and thus removing it without risk of hæmorrhage.

Colectomy.

The other operation for the removal of cancer of the rectum has received the name of Colectomy, and is an important modification recently introduced into the operation of colotomy, viz. the excision of the strictured portion of the intestine, when it lies within reach of the operator, from the wound.¹ This excision is, of course, only possible in exceptional cases; but still, according to Mr. Bryant, these cases are more numerous than is generally believed. Two different proceedings may be followed; i.e. the two portions of bowel may be sewn together and returned into the peritoneal cavity, after the removal of the affected part, or they may be attached to the wound, and an artificial anus formed. It seems from Mr. Marshall's paper on the sub-

¹ See Bryant, 'Med.-Chir. Trans.' vol. lxx. p. 131.

ject¹ that there were then seven cases on record, and that of these four had been successful, two in which the ends of the bowel had been sewn together, and two in which an artificial anus had been formed. It is of course far too early to give any opinion as to the general applicability of this operation. I may merely add that Mr. Bryant, in a subsequent discussion at the Royal Med.-Chir. Soc., states that a very considerable extent of intestine could be examined, and, if necessary, pulled out of the lumbar wound, as much as five or six inches.

The anus, at the junction of the muco-cutaneous surfaces, is not very unfrequently the seat of a cancerous growth, which, when occurring primarily in this situation, is of the nature of squamous epithelioma. In such cases the symptoms of obstruction are sometimes severe, and the patient suffers in the same way as in stricture of the bowel; and to these sufferings those of ulceration of the deposit may be superadded. The disease begins usually as a little nodule, which, in the early stage, may be mistaken for an external pile. After a time it ulcerates, and then presents the characteristic appearances of epithelioma as occurring in other situations. If limited in extent it may advantageously be removed by an operation similar to the one above described for excision of a part of the lower end of the rectum, and in some cases with very favourable results. For if thoroughly eradicated recurrence may not take place for a long period of time, and possibly not at all.

Cancer of the anus.

Malformations of the lower bowel are usually described as either (1) imperforate anus, or (2) imperforate rectum. 1. In the former case there is no anal opening; in the latter there is, but it does not lead into the bowel. When a child is born with no anal aperture the circumstance may escape notice for a time, and then the symptoms are usually complicated by the useless administration of purgatives. Very commonly, however, the malformation is detected soon after birth. If relief is not afforded the usual symptoms of obstruction set in: after a day or two of constipation the belly becomes distended, vomiting commences (the period being dependent in a great measure on the amount of fluid put into the stomach), the food only being rejected at first, and then the meconium, and the child dies in a few days, either from exhaustion or peritonitis. Many of these cases are, however, perfectly curable, and by so simple a proceeding that it should hardly be dignified with the name of an operation. The bowel comes down close to the skin, and if the surgeon will make a moderately free incision in the position of the anus, draw the bowel down to the level of the skin, and attach the mucous membrane to the skin around the whole of the circumference, nothing more need be done. The patient's life will be preserved for the moment, and it may be confidently anticipated that the power of retaining the fæces will be perfect.²

Malformations.

Imperforate anus properly so called.

These are the simplest cases, and they may be recognised conjecturally by the perfect development of the pelvic bones, so that the coccyx is at the normal distance from the scrotum or vagina, and by the bulging in the perinæum when the child cries. A surgeon who would not operate in a case

¹ 'Lancet,' May 6, 1882.

² The sphincter exists in some of these cases, though the anus is imperforate. See a dissection by Mr. Partridge, described in the 'Path. Trans.' vol. v. p. 176. But even if there were no external sphincter, the circular fibres of the internal sphincter would prevent any incontinence of fæces. I have mentioned above that even after the removal of the whole of the lower end of the rectum, considerable, and in some cases practically complete, control over the motions may be regained.

of this kind would, I think, neglect one of the plainest duties of his profession. Yet many such cases are sacrificed to the prejudice that children with imperforate anus had better be left to die.

There are other cases in which imperforate anus is complicated with fistulæ opening into the vagina, into the bladder or the male urethra, or into the scrotum.

When the rectum communicates with the vagina there are cases in which the deformity has produced so little inconvenience that the patient has reached maturity, and even had children, without being sensible of it.² In such cases some sphincter action must be exercised by the fibres of the vagina as the gut passes obliquely through them. But generally the patient suffers the most terrible misery from the deformity, and then an attempt

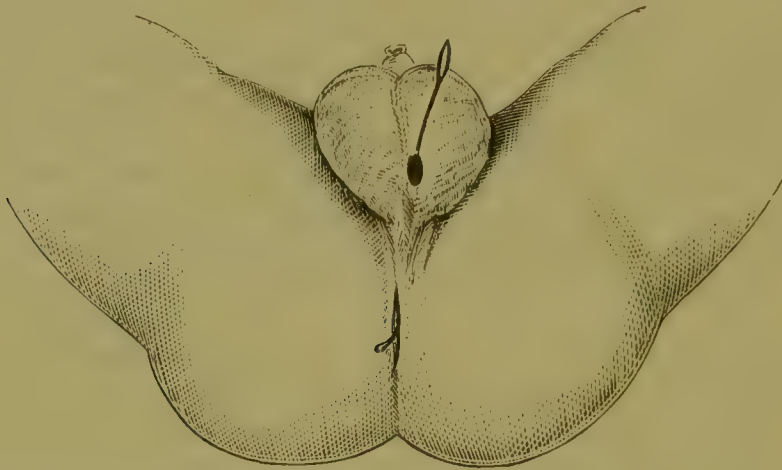


FIG. 348. Imperforate rectum with scrotal fistula. An incision has been made into the rectum from the natural situation of the anus, and a probe passed through this incision from the scrotal fistula. See also Fig. 349.

must be made to draw the bowel down, as is done in simple imperforation, and at the same time to detach it from the vagina, and this is sometimes successful.²

When the opening is into the male bladder or urethra, it may perhaps be possible to draw the end of the rectum down to the natural position of the anus, and fix it there, and so re-establish the normal opening, in which case, if the new anus be kept free, it is to be hoped that the old opening into the urinary tract will close,³ otherwise the only thing that can be done to preserve life—which will otherwise be gradually but surely destroyed by the

¹ A striking case recorded by M. Léon Lefort will be found in my work on the 'Treatment of Children's Diseases.'

² Sigr. Rizzoli published several cases in which the deformity had been treated with much success. I saw a short time ago (Oct. 1887) a woman who was under my care for this deformity when an infant. I operated at that time unsuccessfully. She again came under my care at the age of 18, and I repeated the operation, which seemed to succeed as far as the separation of the rectum from the vagina was concerned, but left her with incontinence of fæces. Now, however, she has perfect control of her motions, the two passages are entirely distinct, and, except that the perineum is somewhat scanty, the parts are perfectly natural.

³ See an interesting case by Dr. Shepherd of Montreal reported in the 'Edin. Med. Journ.' August 1884, in which he succeeded in drawing the bowel down to the skin. The mother's negligence permitted the canal opening to contract, but Dr. Shepherd informs me that he afterwards enlarged it and got the mother to keep it open by passing her finger twice a day. After this the bowels acted naturally and no fæces passed through the penis during the rest of the child's life. He died of bronchitis at the age of 22 months.

accumulation of semi-solid feces in the urinary passages, causing symptoms analogous to stone, or absolutely forming the nucleus for a stone—is to open the bowel higher up, either in the loin or groin.

In cases where external fistula exists the bowel is, I think, never or very rarely far from the integument, and the free re-establishment of the natural passage will usually cure the unnatural one, otherwise a plastic operation may be required.¹

But there are more formidable cases of imperforate anus, in which the bowel is entirely deficient and may terminate at any level, though usually it ends at the sigmoid flexure of the colon, which then sometimes bends over to the right side instead of ending on the left. The deficiency of the rectum may be suspected by the ill-developed condition of the pelvic bones, the

Imperforate anus with deficiency of bowel.

tuberosities of the ischia being close together, and the coccyx near to the parts of generation, and by the absence of all bulging in the perinæum when the child cries. The surgeon is, however, justified in making an exploratory incision—keeping very close to the coccyx as he gets deeper—and if he does not find any bowel it is a matter for his own judgment whether to open a higher part of the gut, and if so which part. I cannot doubt that in healthy infants such an attempt to preserve life should be made, and that the groin is the best place to make the opening. Persons in whom this operation (Littre's) has been performed in infancy have been known to live till middle life or



FIG. 349. Dissection of the parts from the above case. The bowel is seen with the bladder lying in front of it. The bowel terminates in a *cul de sac*, close to the skin, from which a small canal runs forward. This opens on the skin at B, and from thence an almost imperceptible tube can be traced forwards as far as C, where it opens into the urethra. A marks the situation of the anus, while the incision is shown in the previous figure.—From Larcher. Translation of Holmes's 'Surg. Dis. of Childhood.'

beyond it in perfect health and comfort, marrying and taking their part in all the business and pleasures of their station;² and though such cases are undoubtedly very exceptional,³ still I think we are bound to give the patient the chance.

M. Huguier has recommended that in these cases the opening should be made in the right groin instead of in the left, as would seem more natural. His reason is the occasional deviation of the sigmoid flexure to the right side in case of deficiency of the rectum. But this deviation is after all only occasional. I think it better to make the opening in the left groin; and if

¹ Dr. Fenwick of Montreal has been so kind as to send me the particulars of a case of this kind successfully operated on at the age of 27. An artificial anus had been established in the natural position soon after birth, but a large sinus (the continuation of the bowel) persisted, and gave occasional passage to feces.

² See Rochard, 'Mém. de l'Acad. Imp. de Méd.' 1859.

³ Holmes, 'Surg. Dis. of Children,' 2nd ed. p. 173. The more modern experience of these cases, which is certainly also more favourable, will be found in an interesting paper by Mr. H. Cripps in the 18th vol. of the 'St. Barth.'s Hosp. Reports.'

the end of the bowel is not found there a slight extension of the wound upwards will probably enable the surgeon to open it as it bends over to the right side.

Imperforate rectum, in the strict sense.

2. In imperforate rectum (in the proper sense) the anus and the portion of bowel contiguous to it, which are developed, as the skin is, from the external embryonic layer, are natural, and this almost always causes the deformity to be overlooked at first. But as the child can pass no motions the same symptoms come on as in imperforate anus, and then, on examination with the finger, the anus is found to lead into a depression, or *cul de sac*, like a thimble. The bowel terminates at a variable height above. Usually, as in figs. 350, 351, the lower end of the gut is at no great distance; but the condition of parts may be just the same as in imperforate anus, i.e. the gut may end at the sigmoid flexure or at any higher level.

The first thing to be done is to make a free incision, through the skin and soft parts, including the *cul de sac*, from the coccyx as far forwards as the parts of generation permit, having a staff in the urethra or vagina, according to the sex, so that the bladder, uterus, and peritoneal reflexions may be avoided. The incision should be extended as deep as possible by very gradual dissection, the surgeon feeling constantly for the bulging bowel, and when this is reached he endeavours to draw it down and attach it to the external wound before opening it. This proceeding is much facilitated, according to M. Ver-

neuil, by the resection of the coccyx,¹ which can be accomplished by merely extending the wound backwards and cutting the bone across with a pair of curved scissors. When the bowel cannot be drawn down it must be opened

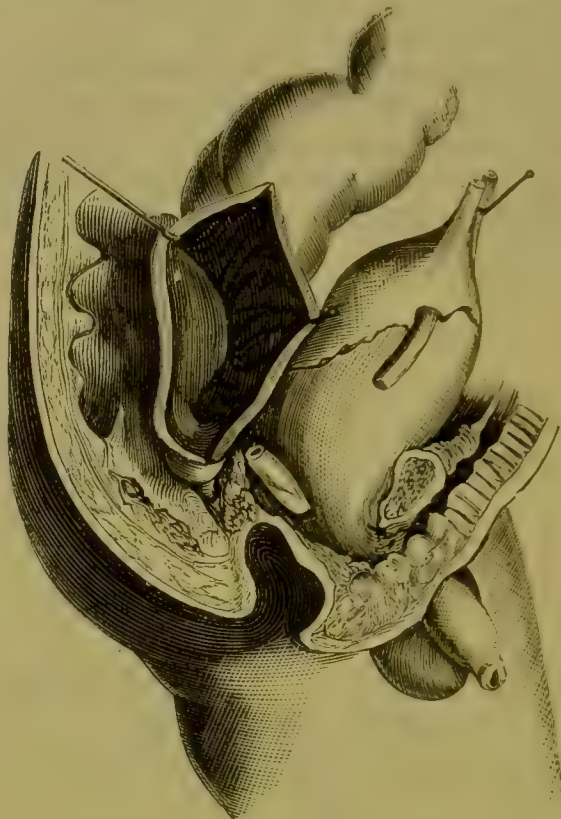


FIG. 350. Imperforate rectum. The bowel terminates at the middle of the sacrum. There is an anal *cul de sac*, separated by a small cellulose-fibrous interspace from the bowel.—After Giraldès.

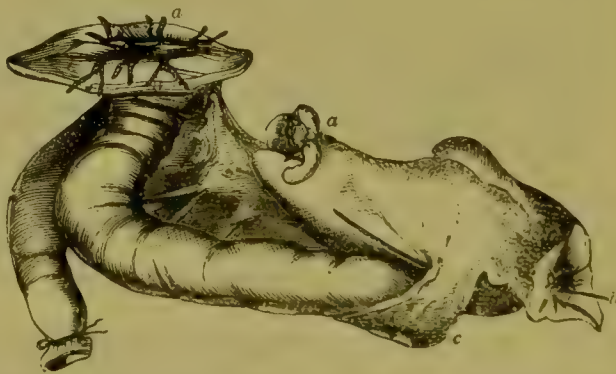


FIG. 351. Parts removed from a case where Littré's operation was performed by Mr. A. Johnstone, in a case of imperforate rectum, after an unsuccessful exploratory puncture, which passed into the recto-vaginal pouch of peritoneum. *a*, the uterus; *b*, a bristle passed in the course of the trocar through the anal *cul de sac* into the peritoneal cavity; *c*, the termination of the rectal *cul de sac* partly invested with peritoneum, and lying close to the track of the trocar; *d*, the artificial anus in the left groin.—From a preparation in the Museum of the Hospital for Sick Children. Holmes's 'Surg. Treatment of Children's Diseases,' p. 172.

¹ See Cripps, 'St. Barth.'s Hosp. Reports,' vol. xviii. p. 81.

in situ, and the patency of the opening maintained either by tents or, what I think is better, by passing the little finger gently through into the gut twice a day. But as these fistulous channels are very liable to close, it is far better, if possible, to draw the gut down.

The old plan used to be to explore the parts with a trocar, but it is an undeniably bad one. The gut may be missed altogether, and the peritoneum or some other part opened (as in the case represented in Fig. 351); or if the upper *cul de sac* is reached and punctured, the escape of air from it renders it more difficult to dissect down on it afterwards, and no puncture with a trocar, however enlarged by subsequent passage of instruments, gives that free exit for the motions which is necessary in after life.¹

In many cases the obstruction of the bowel is formed by a mere membrane, and all that is necessary is to make a free crucial opening and keep it distended by the daily passage of the finger for a month, with occasional exploration from time to time afterwards.

The cases of imperforate rectum in which no gut can be found on exploration must be treated on similar principles to those of imperforate anus with the same malformation. In fact, the presence or absence of a small anal *cul de sac* is quite immaterial.

¹ A most interesting case is reported in the 'Gaz. des Hôp.' June 30, 1877, which shows the lifelong misery and extreme danger to which the method of opening the bowel by a mere puncture may expose the patient. A man, aged forty, died under M. Vulpian's care from an attack of paroxysmal dyspnoea brought on by inability to empty an enormous intestinal pouch, formed by the dilated sigmoid flexure and transverse colon. He had been operated on for imperforate anus, by puncture. This puncture had become cicatricial, intestinal concretions had formed above it, and when the dilated intestine was stopped up by one of these bodies he suffered from terrible dyspnoea, which ultimately proved fatal. So severe was the pressure exercised by the dilated bowel that the vena cava was partly obstructed, and a collateral venous circulation was developed in the walls of the abdomen. All this suffering, and the ultimate death, would have been avoided if it had been possible at the original operation to stitch the mucous membrane and skin together over a sufficient extent to make a wide and non-retractile anus.

CHAPTER XXXIV.

DISEASES OF THE LARYNX.

Laryngo-
scopy and
rhinoscopy.

THE diseases of the larynx have been brought within the field of actual observation, and their treatment has been rendered certain and successful, by the happy invention of the laryngoscope, an instrument which is usually regarded as the invention of Signor Garcia, an eminent musician, though the late Dr. Babington, of Guy's Hospital, is believed to have a prior claim to the distinction. The late Dr. Czermak was perhaps the one who did more than any other laryngoscopist to perfect the details of the method and to extend and popularise its use. Laryngoscopy has now become so universal that a certain amount of familiarity with it may fairly be expected of every practitioner.

The details of instruments vary considerably, and it would be impossible here to speak of their various advantages. All I shall attempt is to describe the essentials of the method. The laryngoscope consists, then, essentially of two mirrors, one the reflector, which is usually fixed to the forehead of the surgeon, who sits in front of the patient; and the other, the laryngeal mirror or speculum, mounted on a stem, small enough to rest between the tonsils on the lower surface of the uvula and soft palate, and inclined at an angle of 45° to the stem. A powerful lamp is placed behind the patient, unless the direct rays of the sun are available (which is but rarely the case). The speculum is warmed by holding its reflecting or glass surface over the lamp-flame or immersing it in hot water till its back is just warm enough to be comfortably borne on the cheek. If it is hotter, the patient's palate will not bear it; if colder, his breath will dim it. He is then directed to open his mouth widely, holding the tongue down if he can, and breathing easily. A person who can show the fauces well, and who is not peculiarly sensitive, requires no preparation; and if the surgeon is dexterous at the examination he can lay the speculum on the uvula and direct the light on to it so as to show the image of the larynx on it at once. This image will be reversed, so that the epiglottis and the convergence of the vocal cords appear to be behind and their divergent extremities with the arytenoid cartilages in front, and the right vocal cord is on the left side of the image. Most patients who are examined for the first time require a little preliminary exercise, especially if in the hands of an inexperienced examiner, for practice gives a precision and a gentleness in manipulating the mirror which are invaluable as aids to successful laryngoscopy; and there are many patients whose fauces are so narrow or so irritable that they can hardly tolerate the lightest touch of even the smallest mirror. Still, with patience on the part of the surgeon and perseverance on that of the patient, almost all adults can ultimately be successfully examined. In children it is sometimes actually impossible to obtain a satisfactory view of the parts. The management of the tongue is often very troublesome. After a little practice most patients can keep it out of the way. If not, the patient may hold the tip of it out of the mouth with his handkerchief or a cloth, or the surgeon may depress it with a spatula. The shape of the mirror

seems to me of little importance, though I prefer a round one ; but it is of unquestionable advantage to use as large a one as the fauces can tolerate.

With the laryngoscope all the back of the mouth and fauces can be thoroughly examined, and in the mirror the epiglottis, aryteno-epiglottidean folds, the apices of the arytenoid cartilages surmounted by the cornicula, the openings of the ventricles, the true vocal cords, and a part of the wall of the trachea (while the glottis is open) can be fully seen. In some cases where the cords are widely apart an experienced examiner can direct the light so as to catch the bifurcation of the trachea.¹ When the parts are fully in view the patient is directed to pronounce the vowel 'A' in tones varying from the lowest to the highest pitch of his voice, so as to throw the vocal cords into free vibration, and show whether they are as movable and as elastic as they should be ; their outline is carefully examined for the marks of ulceration or other injury ; vegetations on the cords or tumours of any other kind in any part of the larynx, or foreign bodies, can hardly escape observation ; and any deviation from the natural colour of the various parts will be readily appreciated by one who has accustomed himself to the examination of the parts in health. This is, indeed, indispensable. No description or book of plates will enable a surgeon to recognise morbid appearances unless he has habituated himself to the aspect of the parts in health, which is perhaps best done by auto-laryngoscopy at first, though it is also very necessary to examine a variety of individuals, in order to learn the way of overcoming the difficulties caused by varying idiosyncrasies, which can only be done by various little changes in manipulation. Success in laryngoscopy can only be obtained by constant practice, and this is still more necessary in order to succeed in the delicate manipulations by which some affections of the larynx must be treated.

The posterior nares and upper part of the pharynx can also be illuminated more or less completely by means of the laryngeal speculum, but the view obtained is far less satisfactory ; still enough can in many cases be seen to enable the surgeon to diagnose with confidence affections which would otherwise be only matters of inference.

Rhino-
scopy.

The instruments are the same, with the addition of a long narrow spatula turned up at the end, or a blunt flat hook, by which the uvula and soft palate are to be gently raised and drawn forward with the left hand, while the mirror, which is somewhat smaller and longer in the stalk than the common laryngoscopic speculum, and has the stem a little bent downwards near its junction with the handle, is passed to the back part of the pharynx. By slight variations of its position and of that of the reflector the surgeon tries to bring successively into view the various parts of the naso-pharyngeal region. Mr. Durham says : ' Under favourable circumstances the two superior meatuses may be inspected and considerable portions of the mucous membrane covering the turbinated bones and the septum may be seen ; the posterior surface of the velum may be examined, and if the mirror is turned towards one side the lateral wall of the naso-pharyngeal cavity and the orifice of the Eustachian tube may be brought into view. But the difficulties of posterior rhinoscopy are great, and it is rarely that the cavities may be inspected to the extent indicated, although this is theoretically possible in most cases, and has been actually accomplished in many.' ²

¹ I think Prof. Czermak was the first to show this on his own person, but many demonstrators of auto-laryngoscopy have been able to follow his example.

² 'Syst. of Surg.' 3rd ed. vol. ii. p. 633.

When the laryngoscopical appearances in health and those in disease to a certain extent have become familiar, the surgeon proceeds to learn the use of the laryngeal brush and the stem by which solutions or solid substances are conveyed to any accessible point of the larynx which may be desired ; and that of the forceps, laryngeal scissors, or guillotine, by which new growths may be removed.

Laryngitis. Laryngitis occurs either in the acute or chronic form. In the former it is a most formidable affection, very dangerous to life, and often proving fatal in spite of the most vigorous and judicious treatment. Its causes are exposure to cold (acute catarrhal laryngitis), the poison of the contagious fevers, small-pox and scarlet fever especially, doubtless from the extension to the mucous membrane of the characteristic affection of the skin (exanthematous laryngitis), the extension inwards of cutaneous or phlegmonous erysipelas (erysipelatous and diffuse cellular laryngitis), and injury (traumatic laryngitis). Chronic laryngitis may also be catarrhal, or phthisical (tubercular), or syphilitic, or it may result from over-use of the voice (clergyman's sore-throat, chronic glandular or follicular disease of the larynx).

Besides these affections, which are found at any time of life and localised in the larynx, there must be added to the list of acute affections the peculiar spasmodic inflammatory affection in children called croup, and the diphtheritic affections of the throat which spread downward into the air-passages.

It would be out of place here to attempt a complete view of the affections of the larynx. I must content myself with a general summary of the more important practical points connected with its acute and chronic diseases, referring the reader for more extensive details to Mr. Durham's excellent essay in the 'System of Surgery,' revised by Mr. Hensman, or to some of the special treatises on the subject.

**Acute
laryngitis.**

Acute laryngitis is characterised by the sudden accession of formidable obstruction, very liable to be complicated by attacks of spasmodic dyspnœa (spasm of the glottis), in which life may easily terminate. The rapidity with which the disease proves fatal in some cases is well known. I have known a man, tolerably well in the early afternoon, who died four hours afterwards ; nor are such cases very rare. The complaint begins with ordinary sore-throat (and probably the catarrhal form usually commences in the pharynx), then feverishness and distress supervene, inspiration becomes difficult and painful, with some cough ; dysphagia increases, the patient begins to hawk up small hard masses, which are supposed to come from the ventricles of the larynx ; then the dyspnœa rapidly increases, expiration as well as inspiration is obstructed, the face becomes livid, the features bathed in sweat, the pulse small and intermittent, and death follows either from spasm of the glottis, from sudden suffocation without spasm, or from more gradual obstruction preceded by unconsciousness.

The treatment of this formidable disease must necessarily be vigorous and decisive if the patient is to have any chance. In the first stage, when dysphagia and dyspnœa, for which there is no other cause present, point to the spread of pharyngitis over the epiglottis to the larynx, a careful inspection of the fauces (with the laryngoscope, if the patient can tolerate it, if not with as good a light and as free an opening of the mouth as can be procured) is essential ; and if, as will probably be the case, the parts about the aryteno-epiglottidean fold are found congested and thickened they should be very freely scarified. At the same time antimony and aconite should be given in

small but frequent doses.¹ If the inflammatory appearances are less decided, the patient should be enclosed in a warm, moist atmosphere, and the throat should be constantly steamed with simple steam, or the same mixed with henbane or hops; or the inflamed membrane may be carefully pencilled with a very strong solution of nitrate of silver (3i. to ʒi.).

But if, as too often happens, the symptoms advance, laryngotomy must not be delayed. Unfortunately it seldom saves the patient's life; but it is his only chance, and the earlier it is performed the better for him. There is no necessity for opening any part of the tube lower than the crico-thyroid interval in these cases. Sir P. Hewett has shown that the œdema never extends below the vocal cords, so that the ordinary operation of laryngotomy will give the patient the means of breathing, but in most of the cases I have seen he has sunk nevertheless. In many of these instances, especially when occurring in later life, the kidneys will be found diseased; otherwise I do not know how to account for the fatality of the affection. After the opening is established I do not think any further employment of depressing remedies is indicated. The pulse and temperature should be watched, and the patient supplied with stimulants and nourishment in accordance with his condition.

The above refers to the catarrhal form of acute laryngitis. In the exanthematous forms no scarification and no depression should be thought of. The only question is, whether laryngotomy will give the patient any further chance of survival.

When erysipelas in either of its forms extends inwards to the larynx the complaint is usually fatal. Still, instances of successful laryngotomy are not wanting, and the operation should not be long delayed.

In traumatic cases, as I have stated above (page 197), the operation should always be performed early, when there are loose portions of cartilage hanging into the larynx, or the mucous membrane has been penetrated by the edge of a fracture. For the treatment of laryngitis which follows burn or scald I would refer to page 203.

The acute laryngitis of croup is not preceded by pharyngitis, as the common catarrhal laryngitis is, nor is there any diphtheritic or croupous membrane in the pharynx or mouth, as there is in diphtheria. Still, the resemblance or relationship between croup and ordinary laryngitis on the one hand and diphtheria on the other is very close, so that many authorities regard croup and diphtheria as essentially the same disease—an opinion which is strengthened by observing that in epidemics of croup there are cases in which the false membrane does extend into the fauces, and which are called 'diphtheritic croup.' Croup sets in with feverish symptoms and a hard, dry, ringing cough, without dysphagia, but soon running on to considerable dyspnoea, aggravated into formidable paroxysms, and accompanied by cough and expectoration, in which very commonly shreds of false membrane may be observed. Inflammation rapidly extends down the trachea to the bronchi, the breathing becomes more oppressed, so that the sides of the neck are seen to be drawn in during inspiration, the face becomes livid, consciousness oppressed, and the child dies asphyxiated.

Croup, or
cynanche
trachealis

In this formidable disease there are two stages to be considered in the treatment—the first that which occurs before the dyspnoea has become very

¹ Mr. Durham prescribes two or three minims of the Vin. Ant. with one or two drops of Tinct. Aconit. (B. P.) and half a drachm of Liq. Ammon. Acet. in some vehicle every quarter or half hour till some obvious effect has been produced on the pulse, and then the same less frequently.

dangerous, when there is sufficient evidence of acute laryngeal inflammation spreading down the trachea, but the breath still comes pretty freely. In such cases anatomical examination would show the larynx inflamed, and more or less coated with a fibrinous or leathery exudation, which extends some distance down the trachea, but does not line the whole of it nor reach the lungs. During this stage emetics, leeches to the chest, and the free use of antimony are the measures indicated. Some practitioners rely much on mercury, on account of its solvent action on fibrinous exudations; but, as Dr. Barclay has pointed out, that action is too slow to be available in croup. At the same time mercury may be combined with antimony, on which latter drug, no doubt, the chief reliance is to be placed. Warm fomentation, with opiate liniment to the throat, and the creation of a warm, moist atmosphere round the bed, are decidedly useful. Most cases of croup are thus brought to a favourable issue. But in the second stage, when the respiration is very laboured, and the subclavicular spaces are seen to be depressed in every effort at breathing, when the child is becoming livid and oppressed, yet the lungs are not much loaded, tracheotomy becomes urgently necessary. At this period it will be found that the glottis is extensively trenched upon by the exudation which now nearly fills the larynx, and which is beginning to extend beyond the bifurcation of the trachea. If the operation is delayed till the lungs also become much loaded it is useless to perform it.

Opinions differ as to the place which should be selected for the operation. My own is in favour of operating above the thyroid isthmus; for though, if we could make sure of getting below the lower end of the inflammatory membrane, it would no doubt be worth some risk and trouble to attain this object, yet the extra half or three-quarters of an inch which is the distance between the incisions in the two operations is quite useless for this purpose, while the operation below the thyroid isthmus is in a fat child a very dangerous one.

The more the disease approaches to pure diphtheria the less is the prospect of relief from tracheotomy, though the chance of relief should not be refused, as numerous examples of recovery have been recorded, even when the patient's condition has been regarded as desperate.

Laryn-
gismus
stridulus.

Clearly distinguished from croup or diphtheria is laryngismus stridulus, or 'child-crowing,' a spasmodic affection allied to convulsions, often very alarming, but accompanied by no general fever and by no exudation, therefore having intervals of perfect remission, and to be treated, not by the administration of depressing remedies, still less by tracheotomy,¹ but by bringing the child slightly under the influence of chloroform when the spasm comes on; or, if the spasm is not very powerful, by the use of the warm bath.

The success of tracheotomy in croup will depend a good deal on the period at which it is employed. If the surgeon resorts to the operation early, and is dexterous in its performance, a large proportion of his patients will recover; but then a good many of these would certainly have recovered without. Nothing seems to me to show the fallacy of statistical reasoning in matters of practice more than the conclusions hastily drawn from the great apparent success which attends the operation of tracheotomy for croup in the hands of surgeons who perform that operation very frequently. Without denying that an early resort to tracheotomy *may* be better practice than

¹ There are, it is true, a very few exceptional cases in which the mere spasm has been so severe as to prove immediately fatal; and here it is necessary to open the trachea, if the surgeon happens to be present; but the occurrence is an exceedingly rare one.

waiting till the child is nearly *in extremis*, I would point out that this conclusion rests on observation, and cannot be proved by quoting numbers.

The constitutional forms of chronic laryngitis are all marked by the prominent symptom of aphonia rather than by any danger to life, though any of them may become dangerous to life when complicated with ulceration, since that ulceration may irritate the vocal cords and produce spasm of the glottis, or may extend to the cartilages, and portions of the necrosed cartilage may become displaced or entirely loose and act as a foreign body.¹ In 'phthisis laryngea' the disease consists, as it seems, in the development of tubercle beneath the mucous membrane of the epiglottis and larynx, which runs on with more or less rapidity to ulceration, leading to loss of voice, destruction of the epiglottis, dysphagia, cough, expectoration, necrosis of the cartilages, and death. As a general rule the disease in the larynx is only a part of the general affection, and the patient's death is due to the disease in the lungs; but in other cases the complaint commences in the larynx, and may, indeed, be confined to it. The treatment of the disease must, of course, be regulated by the general condition. When the lungs are profoundly affected nothing can be done beyond soothing the patient's sufferings by steaming the larynx from time to time with hot water mixed with henbane or stramonium, touching any ulcers which may be visible on laryngoscopic examination with a wire coated with nitrate of silver or with a solution of nitrate of silver on the laryngeal brush, and enjoining rest to the laryngeal organs as much as possible. Even in these hopeless cases, however, Mr. Durham urges the occasional justifiability of tracheotomy as a palliative, if the patient is greatly troubled by pain or difficulty of breathing; while there are doubtless cases in which the laryngeal disease is the essence if not the whole of the complaint, and in which tracheotomy is urgently indicated.

Chronic
laryngitis.
Phthisical.

Syphilitic laryngitis is either secondary or tertiary, and the affections of the larynx appear to bear a general resemblance to the secondary and tertiary phenomena of syphilis in other parts of the body. Thus the secondary laryngitis seems to depend usually on the spread of roseola or psoriasis from the throat, or on the development of similar affections, or of mucous tubercles, on the laryngeal mucous membrane. Secondary ulceration may also spread from the fauces down to the larynx, and may either destroy the vocal cords partially or completely, or may so displace and bind them down as to prevent their proper action, and so lead to permanent aphonia.

Syphilitic
laryngitis.

Secondary laryngitis as a rule involves no worse consequence than loss of voice, which is usually only partial and temporary, though when ulceration or inflammation occurs in the neighbourhood of the cords the patient is, of course, never free from the danger of spasm.

The tertiary affections of the larynx are more deep and more dangerous. Some of them seem to consist in warty growths in the larynx, not unlike the syphilitic vegetations or condylomata found elsewhere; but the chief tertiary affection of the larynx is ulceration, which rapidly extends to the cartilages and vocal cords, destroying the larynx as an instrument of voice and producing the most serious danger to life.

Syphilitic affections of the larynx can usually be diagnosed from other diseases by concomitant symptoms; but in any case of doubt the effect of anti-syphilitic remedies will assist the diagnosis. The exhibition of mercury

¹ There is even a case on record in which a diseased gland made its way by ulceration into the trachea, and a portion of it dropped into the tube, producing the usual symptoms of foreign body.

in the form of calomel vapour, inhaled through a mouthpiece attached to the common mercurial lamp, or the repeated application of the Liq. Hyd. Perchlor., pure or diluted with an equal bulk of water, are the most useful applications in syphilitic sore-throat. In secondary affections the patient should undoubtedly be brought fully, though gradually, under the influence of mercury. In the tertiary stage of the disease iodide of potassium with tonics may be given internally while the local mercurial treatment is being carried on. In these, as in all other ulcerative diseases of the larynx, the surgeon must be prepared for the necessity of tracheotomy, and must not let his patient die, or run any serious danger of dying, for the want of an opening through the crico-thyroid membrane.

Follicular
laryngitis.
Dysphonia
clericorum.

The follicular disease, or dysphonia clericorum, has its seat in the glandules or follicles of the mucous membrane, and is often accompanied by a similar affection of the mucous membrane around. 'The membrane covering the arytenoid cartilages and immediately adjoining parts is more rich in glandular structures than any other portion of the laryngeal mucous membrane. Now, this part is constantly subject to a very great extent of motion, and also perhaps to considerable strain, during forced vocalisation.'—(Durham.) Thus is explained the prevalence of this complaint in those whose occupation leads to constant exertion of the voice, though it occurs in others also: in photographers, according to Gibb, who are exposed to acrid chemical fumes; and in persons labouring under the herpetic diathesis, according to Trousseau and others.

'The symptoms are: alteration of the voice and sense of effort in sustaining it—these are by far the most prominent and constant symptoms; more or less discomfort about the larynx, never amounting to pain, but occasionally troublesome; dryness and sometimes a sense of heat about the throat; and constant desire to clear the throat by "hemming" and "hawking." There is little or no regular cough; and the expectoration which sometimes occurs is slight, scanty, and mixed with saliva. There is neither difficulty in swallowing nor tenderness upon pressure over the larynx. There are no definite constitutional symptoms, but the general health and spirits of the patient are often observed to be more or less depressed.'

¹

The voice is much affected in these cases, and especially in distinct or loud speaking or reading. The mucous membrane of the fauces and throat as well as that of the larynx is seen in the early stage of the complaint studded with enlarged glands, surrounded by an area of redness, and at a later period these may have formed small points of ulceration; but it does not seem that the deeper structures are liable to disease or that the larynx is ever incurably disorganised.

The local treatment consists in the persevering application of astringents, nitrate of silver, tincture of iodine, sulphate of zinc or copper, in such strength as is found to be suitable, touching the ulcerated parts with the solid nitrate of silver, and the inhalation of pulverised solutions of 'common salt, chloride of ammonium, iodide of potassium, and in some cases alum or weak solutions of perchloride of iron.' Mr. Durham says also that benefit may be derived from sucking medicated lozenges (chloride of ammonium, with or without cayenne, and the 'red gum lozenges'), and from wearing the beard. The general health must be carefully attended to, and the patient may be comforted with the assurance that though the treatment may be tedious there is every reason to hope ultimately for complete success.

¹ 'Syst. of Surg.' 3rd ed. vol. ii. p. 674.

The diagnosis of tumours of the larynx is due exclusively to the laryngoscope. Formerly, though the existence of such tumours might be guessed at, it could never be affirmed. Now they can be seen, and, what is of far more importance, they can often be removed without any incision or any inconvenience whatever, and the patient in some instances restored to the full use of the voice, and in all rescued from the imminent danger of suffocation which is incident to the presence and growth of a tumour in the neighbourhood of the glottis.

Most of the tumours which affect the larynx are common warts or papillomatous growths,¹ which spring up from any part of the mucous membrane, sometimes in considerable number, and often grow to a very large size. They are sometimes congenital. They are said to spring more commonly from the front of the larynx, near the convergence of the vocal cords, though they may grow in any part of the cavity of the larynx, or even in the trachea.² Fibrous tumours are next in number, some of which are sessile, growing from the sub-mucous tissue; others are pedunculated, like the polypi of other parts. Adenoid growths are rare, and grow from the mucous glands at the base of the epiglottis, the aryteno-epiglottidean folds, or the membrane covering the epiglottis. A few instances of cystic, myxomatous, cartilaginous, and osseous tumours are also recorded. These are the innocent forms of tumour—the malignant growths are mostly epitheliomatous, though instances of sarcoma are not wanting. Epithelioma is generally an extension from the pharynx; but it sometimes begins, as Mr. Durham describes it, on the mucous membrane lining the back of the cricoid cartilage, and doubtless in other parts of the larynx also, in the form of small irregular nodules, which gradually increase in size and soon ulcerate. In any case the tumour will soon present an ulcerated surface, and can then be recognised from the other forms of ulceration by its elevated edge, by its dirty grey colour, by the amount of new deposit, causing irregular thickening in the parts around, and in some cases by the presence of enlarged glands.

The symptoms caused by a tumour of the larynx are the same as those accompanying any other chronic affection, viz. aphonia, more or less complete; hoarseness, cough, occasional dyspnoea, sometimes aggravated into fits of spasm, and in some cases (chiefly those of cancer) more or less dysphagia. The more movable and pedunculated the growths are, the more liable are they to cause spasm of the glottis, while the degree of permanent obstruction of course will depend mainly on the size of the growth.

The diagnosis can only be arrived at by laryngoscopy, unless in the rare instances (chiefly in childhood) in which the growths can be felt by passing the finger round the epiglottis. If any doubt exists as to the nature of the growth, it can generally be settled by removing a fragment with the laryngeal forceps and submitting it to microscopic examination.

The treatment of a tumour of the larynx is directed to fulfil two different indications, viz. either to remove the growth altogether or to protect the patient from the danger of suffocation by tracheotomy. Of the performance of laryngotomy or tracheotomy, in order to avert suffocation by a tumour,

¹ Out of 244 cases of laryngeal tumour collected by Mr. Durham 110 were of this nature—19 only were cancerous.

² See a very interesting case recorded by Mr. Butlin in 'St. Barth.'s Hosp. Reports,' vol. xviii. p. 129, in which a large papillomatous tumour was successfully removed by tracheotomy. It was 'attached below the cricoid cartilage, to nearly half the circumference of the trachea and for more than an inch downwards on the left side.'

I need say nothing further ; the indications are the same as in spasm of the glottis, or alarming dyspnœa from any other cause. There are various ways of removing laryngeal tumours. There may be small warty elevations hardly deserving the name of tumours, yet quite sufficient, if seated on the cords, to produce aphonia, and which may be repressed by touching them with the nitrate of silver, fused and applied to the end of a bent wire, or by means of a wire carefully conveyed down to them and connected with a galvanic battery ; but this last manœuvre is a very delicate one, and the surgeon must first well exercise himself and his patient to see that he can always bring the wire into unfailing contact with the little growth.

Removal
from the
mouth.

More commonly, however, the growths which are large enough to produce symptoms are also large enough to be seized and removed by delicate forceps of appropriate shape and construction, or by a snare or *écraseur*, constructed on the same principles as Hilton's snare for nasal polypi, figured on p. 647, with the necessary modifications in size and shape ; or by a knife, scissors, or guillotine, i.e. an instrument which is slipped over the tumour, when pressure on a handle projects a blade which cuts it off. Laryngeal growths have also been removed by the galvanic cautery, though the method seems unnecessarily dangerous, and those which are cystic have disappeared after simple puncture.

In all cases where it is possible the method of removal from the mouth ought to be adopted. But sometimes, from the age of the patient, from his intolerance of the necessary manipulation, or from the size and attachments of the tumour, it may become necessary to remove it by external incision.

Thyro-
tomy.

Thyrotomy, as the operation is called, is an extension of laryngotomy, the incision into the larynx being continued upwards between the *alæ* of the thyroid cartilage. It is best done, I think, at two different sittings. The usual opening having been made through the crico-thyroid membrane, the patient is relieved from all danger of suffocation, and the ordinary tube is inserted. Then, at a subsequent day, a tampon-tube is introduced and the windpipe securely plugged (the patient being, of course, fully narcotised, which is readily effected by administering the anæsthetic through the tube), and the incision is slowly and cautiously carried along the middle line of the *pomum Adami*, so as to wound neither vocal cord, till the thyro-hyoid membrane is reached. I think it will often be found more convenient to commence the incision above at the notch between the two halves of the thyroid cartilage, and prolong it downwards very steadily and carefully in the middle line till the tracheotomy wound is reached. A couple of blunt hooks will now drag the two halves of the larynx apart. If there is much bleeding (as there often is) a piece of sponge must be firmly pressed into the larynx till it has subsided. The patient is all this time breathing quietly through the tampon-tube. On the subsidence of the bleeding the whole interior of the larynx, with the mouths of its ventricles, will be exposed, and the tumours can be cut away, their bases cauterised, and any other manipulation carried out most satisfactorily. The same proceeding is sometimes required for the removal of foreign bodies impacted in the ventricle (see p. 198), and under urgent circumstances it is of course performed at one sitting.

Extirpa-
tion of the
larynx.

Latterly, still more extensive operations have been practised for malignant and other extensive diseases of the larynx, all the parts affected having been removed, so as to extirpate the whole larynx and lay the pharynx freely open. In a case under Mr. Pick's care,¹ at which I assisted, I thought the

¹ 'Clin. Trans.' vol. xiv. p. 163.

operation justifiable, as the patient was evidently sinking, and as there was considerable doubt whether the disease was not innocent in its nature, and it appeared possible to remove it entire. In such cases it seems reasonable to give the patient the chance which the operation may hold out ; while in cases obviously of a malignant nature, the propriety of extirpating the larynx is very dubious, since the disease will almost certainly recur very soon, and the immediate risk to life is extremely great.¹

The operation in the case referred to was thus performed. Tracheotomy having been practised on a former day, the trachea was completely plugged with Semon's modification of Trendelenburg's tampon, and all risk of suffocation from blood running into the windpipe thus averted. Then the parts over the thyroid cartilage were freely divided by a crucial incision and the thyro-hyoid membrane denuded and incised on one side as far as the upper cornu of the thyroid cartilage, which was then severed from the hyoid bone. The lower cornu was then separated from the cricoid cartilage, and the thyroid and cricoid cartilages divided in the middle line. One-half of the thyroid was then removed, and afterwards of the cricoid. Then the other side was similarly treated, the whole operation being performed with curved blunt-pointed scissors. In this way all the vessels divided (which were few and small) were secured at once with clips, and hardly any blood was lost. No vessels required a ligature. The pharynx was of course widely opened in removing the posterior part of the cartilages.

The practicability of complete removal of the larynx, without causing the death of the patient, has been abundantly proved, but the propriety of the operation is doubtful. A large number of the cases in which it has been performed have died from the direct effects of the operation (according to the latest statistics more than two-thirds), and in those who have survived, the subsequent history of the case has not been encouraging ; recurrence in a large proportion having taken place within a few months. When, however, the disease is confined to one side of the larynx, partial extirpation seems to present a much more favourable aspect. It would appear to be a far less fatal operation ; it mutilates the patient much less, and does not interfere with deglutition and speech in the same way that entire extirpation does, and it is stated not to be followed more rapidly by recurrence of the disease than complete removal of the organ.

After recovery an apparatus can be adapted, in the place of the larynx, consisting of a box with a vibrating tongue inside, by means of which the patient can articulate very completely—at least quite sufficiently for practical purposes.

In connection with these operations for the removal of parts of the vocal apparatus, I ought to mention a case related by Mr. Lister and Dr. B. Yeo to the Clinical Society,² in which, after thyrotomy, Mr. Lister removed the whole of the true vocal cords along with some warty growths, and the patient recovered the power of complete and even loud articulation, his voice being perfectly audible over a tolerably large room. Mr. Lister attributed the restored voice to the vibration of the aryteno-epiglottidean folds.

¹ I performed the operation in a case of this kind in May 1884. The operation was, however, unsuccessful, as the disease on one side extended up towards the base of the skull and could not be entirely removed. There was no difficulty in the operation itself nor any formidable bleeding. The patient, who was much pulled down before he came under my care, died on the second day.

² 'Clin. Trans.' vol. xi.

Aphonia,
nervous
and hys-
terical.

Aphonia, besides being a symptom of all chronic laryngeal disease, occurs also from causes unconnected with any disease in the larynx. The nervous or hysterical aphonia, which is often seen in young women—though sometimes in men—is an affection not very well understood, and sometimes devoid of any other symptom of hysteria or nervous disease, though agreeing with such disorders in the fact that there is no visible degeneration of tissue in the parts affected, and that the function may often be completely and immediately restored without any visible cause for the change.

In a case of this kind laryngoscopic examination will show all the parts of their natural appearance, but the motion of the cords is variously affected. The voice sometimes appears and disappears quite suddenly, and in all cases there is the same want of proportion between any recognisable cause and the presumed effect which is noticeable in other 'nervous mimeries.' There may have been some little cold or some extra exertion of the voice alleged as the cause, but this is wholly insufficient to account for a total inability to speak.

These cases often get well of themselves, or any method of treatment may cure them—the mere introduction of the laryngoscope has produced a return of the voice.¹ The approved methods of treatment seem to act by giving the patient a shock—a 'shake-up,' as Mr. Durham terms it. Such are the pinching or squeezing of the larynx, the application of galvanism either to the cords themselves or to the parts near them, the application of strong or irritating lotions to the interior of the cavity, such as solutions of nitrate of silver or sulphate of copper, and the application of irritating fumes, as those of solutions of ammonia or chlorine.

Aphonia is said also to result from idiopathic atrophy of the muscles of the larynx, but on this head little, I believe, is known.

Usually, when a patient has lost his voice, and on laryngoscopic examination one of the vocal cords is seen to be motionless, the cause is to be sought in pressure on the recurrent nerve, and the commonest cause of that pressure is either an aneurismal tumour, especially aneurism of the aorta pressing on the left recurrent, or an enlarged gland, or a malignant tumour in the thorax or neck. It is not very uncommon for a person to be unaware of the existence of aortic aneurism until the attention of his physician is called to the part by either paralysis or spasm of the glottis. And there seems good reason to believe that the pressure of a tumour on any part of the windpipe may set up irritation in its substance which may be so reflected down the nerves of the part as to produce either paralysis or spasm of the cords without any direct interference with the nerve-trunks.

Aphonia
from
paralysis.

Spasm of
the glottis.

Spasm of the glottis is one of the most painful and most fatal of all surgical accidents. It comes on from the most various causes, and may terminate life in a few minutes, if prompt help be not given. That help lies in the immediate opening of the windpipe below the glottis; and when, as sometimes happens, a patient is found in obvious and imminent danger of death from spasmodic dyspnoea, of the cause of which the bystanders can give no account, the surgeon's duty is to make an opening at once through the crico-thyroid membrane, and if necessary perform artificial respiration through the opening. But what has been said above is sufficient to show that in many cases of spasm of the glottis the immediate opening of the windpipe is unnecessary, and fortunately it is only in rare emergencies that we have not the opportunity for more deliberation in the treatment.

¹ See Durham, in 'Syst. of Surg.' 2nd ed. vol. iv. p. 592.

The chief causes of spasm of the glottis have been pointed out in the foregoing pages. They are: foreign bodies fixed in the larynx or loose in the lower part of the windpipe when they impinge on the cords, burns and scalds of the larynx, inflammation and ulceration (whether acute or chronic) trenching on the neighbourhood of the cords, tumours when they move so as to get between the cords, aneurisms, tumours, and enlarged glands irritating the recurrent nerves or pressing on the windpipe, and central irritation, such as is often seen in tetanus and less frequently in cerebral affections. The treatment of all these conditions has been discussed, so far as they fall within the surgeon's province, and the necessity of tracheotomy under certain circumstances pointed out. I would merely add that the patient's safety is best consulted in circumstances of doubt by resort to operation, rather than by hesitation, which may at any time involve fatal consequences.

The windpipe may be opened in three different positions, viz. between the cricoid and thyroid cartilages, above the thyroid isthmus, and below it. All three operations are often comprised under the common name Tracheotomy, which is thus used as synonymous with Bronchotomy, meaning any operation by which an artificial opening for respiration is made; otherwise the word Bronchotomy is used for all the operations on the air-passages, while the term Tracheotomy is restricted to the operation below the thyroid isthmus, that above it being called Laryngo-tracheotomy, and the operation through the crico-thyroid interval Laryngotomy.

Broncho-
tomy or
tracheo-
tomy.

Laryngotomy is the easiest of the three. Nothing is necessary except to keep in the middle line, to divide the skin pretty freely from the thyroid to the cricoid cartilage, and to cut through the crico-thyroid membrane entirely from the lower border of the thyroid to the top of the cricoid cartilage, or horizontally to a sufficient extent, and then insert the tube. In urgent cases there is no need to make any preliminary incision. The knife can be plunged direct into the windpipe, and the tube may follow it at once. No vessel of importance can be injured. The little anastomotic arch formed by the crico-thyroid arteries never, as far as I know, furnishes more than slight hæmorrhage, which is stopped at once by the pressure of the tube.

Laryngo-
tomy.

Laryngotomy is often required under circumstances of urgency when no tube is at hand. A pair of forceps, or in the last resort the blades of a pair of scissors, or a couple of hairpins or pieces of bent wire, will suffice to keep the wound open, and if necessary the operation can be done with a common penknife.

This operation is sufficient in all cases which involve only the vocal cords or the tissues above them. It is, therefore, practised in spasm of the glottis from all causes, including burn and scald, in erysipelatous affections spreading down the throat, and in cases of foreign body lodged in or above the glottis. Opinions differ as to the operation which is to be employed in cases of laryngitis and croup, as to which I have already expressed my own.

Laryngo-tracheotomy consists in making a freer incision than in laryngotomy from the lower border of the pomum Adami to about three-quarters of an inch below the cricoid cartilage, dissecting the parts till the trachea and the isthmus of the thyroid body are plainly seen, plunging the knife into the windpipe with its back to the thyroid isthmus, and cutting upwards through the two upper rings of the trachea and the cricoid cartilage.

Laryngo-
tracheo-
tomy.

This operation is chiefly used in childhood, when the small size of the

larynx seems to forbid laryngotomy, and the depth and shortness of the neck renders tracheotomy dangerous.

Tracheo-
tomy
proper.

Tracheotomy below the thyroid isthmus requires a freer opening and a deeper dissection. The extent of the incision will, of course, be proportioned to the thickness of the neck. In a short deep neck there is no objection to extending the incision from the cricoid cartilage to the episternal notch, but this is rarely requisite. An average incision would be from an inch and a half to two inches downwards from the cricoid cartilage. Having divided the skin and deep fascia, the sterno-thyroid muscles may be seen touching each other in the middle line, and these parts should be drawn asunder with hooks. Any vessels (arteries or veins) which bleed freely had better be tied; ¹ the lower border of the thyroid isthmus will be recognised, and may be drawn up with a hook if it is unusually broad. The trachea should be dissected clean till three rings are seen fairly exposed, and should then be opened in the whole extent which is denuded, with the edge of the knife turned upwards. Then the tube is to be inserted. If the thyroid isthmus comes down unusually far it is safer to divide it in the middle line than to risk a deep dissection close to or under the sternum. In following the other course I once lost a patient from wound of a branch close to the innominate vein.

There are a few precautions which are essential to success in all these operations. The first is to keep in the middle line, and this is not always easy in cases which are operated on late at night under urgent circumstances. The head ought to be extended, as much as is possible without increasing the dyspnœa, by putting a pillow under the neck and shoulders; and the surgeon, if he has no trained assistant, must see that the head is held firmly and the body kept straight. Next it is desirable to stop the bleeding before the trachea is opened; but if the bleeding is merely venous or capillary, and from a number of imperceptible vessels, the best plan is to make the opening at once. If a gush of blood passes into the windpipe the patient must be instantly turned on his face, and it will run out again. The free admission of air into the lungs will relieve the venous congestion, and the hæmorrhage will cease. It is most important to make a free opening at first, so that the tube has ample space. I have seen the patient die while the operator was vainly endeavouring to force a tube through an opening too small for it, and thereby of course increasing the dyspnœa. There is no objection in most cases to the administration of chloroform, nor is there usually any reason for hurry in the dissection. A quiet and methodical dissection may take a minute or two longer than one where haste is the only thing thought of; but it often really saves time, as it enables the operator to insert the tube at once instead of boggling about it. As to the insertion of the tube, there is not generally any difficulty if the windpipe has been opened with the

¹ Mr. Hulke, in a paper in the 'Med.-Chir. Trans.' vol. lx. p. 92, gives the following practical hint from a German treatise on Tracheotomy, the reference to which he had mislaid:—

'The venous plexus overlying the trachea is enclosed between two folds of the deep fascia which pass upwards to the larynx. The veins also are much smaller above than lower down. If this fascia is fixed by pressing the nail of the left forefinger against the front of the cricoid cartilage and a small cut be made upon this transverse to the axis of the trachea, both these folds of fascia will be divided. If now the lower lip of the cut fascia be seized with forceps, the fascia below enclosing the veins (and isthmus of the thyroid gland if necessary) may be easily peeled down with the thin handle of the scalpel, exposing the front of the trachea by an almost bloodless dissection.'—Mr. Hulke relates a case in which he adopted this manœuvre with much success.

requisite freedom. The old solid cannula is now rarely used. Fuller's bivalve cannula is the one most commonly met with, but possesses this great disadvantage, that it may cause ulceration, and even fatal hæmorrhage, by



FIG. 352. Fuller's bivalve tracheotomy cannula. The cannula is introduced with its blades closed. Then, by depressing the handles to the position marked by the dotted lines, the blades are opened, and a tubular cannula is introduced between them.

reason of the sharpness of the edges of its outer cannula. Durham's right-angled cannula is probably the best. Its shape is better than the ordinary quarter-circle one, consisting as it does of a straight piece for the wound, and a short piece at right angles to drop into the trachea without touching its back wall. It can be lengthened and shortened according to the depth the trachea is from the surface of the wound. By means of the 'lobster-tail' director it is very easy to insert. Whatever form of

tube is used it should be double, for it will soon become obstructed with mucus, and the inner tube must often be withdrawn for the purpose of cleansing it. For the same reason the inner tube must project beyond the outer one, otherwise the withdrawal of the inner tube might leave the outer one obstructed.

When the double cannula is securely lodged in the trachea it must be tied in with a piece of tape round the neck; and if there is any superfluous

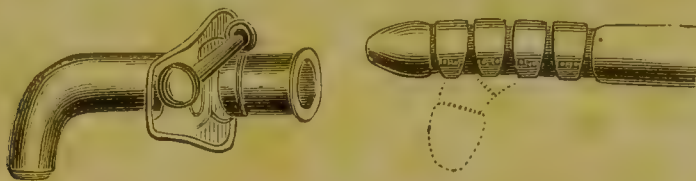


FIG. 353. Durham's cannula, with 'lobster-tail' director.

incision it may be united with one or two stitches. Several dangerous complications may occur after the operation. The secretion (especially in the diphtheritic affections) will collect in the tube and must be assiduously removed by passing the feather of a pen down the inner tube, and when this no longer serves, by removing the inner tube and clearing it. It may even become necessary to remove the outer tube also and draw up the croupous membrane out of the trachea. I have seen a complete cast of the trachea and bronchi thus removed, with immense relief to the dyspnoea. Cases have been recorded¹ in which the trachea was lined with false membrane and the tube was passed in between the latter and the wall of the trachea, thus closing the passage for the air entirely. This might be suspected to have happened when the tube, though obviously lodged in the trachea, transmits no air. The best course to adopt, I imagine, would be to dilate the tracheal wound with hooks, when the membrane would probably protrude and could be removed, or, at any rate, freely lacerated.

Again, the pressure of the end of the tube against the windpipe sometimes produces ulceration of the trachea, which has even been known to extend into the innominate artery, and still more frequently induces tracheitis and bronchitis. To obviate this Mr. Bryant has devised a cannula in which the shield lying on the skin is jointed to the stem which rests in the trachea, in order that the tube may follow the motions of the

¹ 'Non-penetration of the lining false Membrane an unnoticed Danger in Tracheotomy,' by Mr. A. G. Osborn, of Dover.—'Brit. Med. Journ.' 1885, vol. i. p. 127. See also Howard Marsh, 'St. Barth.'s Hosp. Reports,' 1867.

windpipe. But the presence of the foreign body must always cause some irritation, and this seems often to be the starting-point of general tracheitis and bronchitis. In order to lessen as far as may be this irritation, and yet not to lose the security against sudden suffocation which the tube affords, the use of flexible india-rubber tracheotomy tubes has lately been advocated.¹ They are no doubt very comfortable, and when the tube has to be worn for a length of time are, in my opinion, very superior to the silver tubes, as they allow the patient to move his head without any distress from the impact of the end of the tube on the interior of the windpipe. Also, when the silver

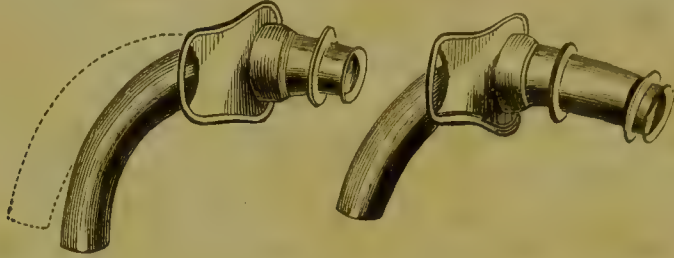


FIG. 354. Bryant's cannula. The shield is movable on the neck-plate by means of a joint, and can be shortened if required.

tube sets up much inflammation shortly after the operation it is well to try an india-rubber one. But great care should be taken to see that the tissue of the tube is not rotten—that the tube can be bent and pulled about freely without cracking—otherwise it may easily break and leave its end in the air-tube.² This accident may possibly be obviated, as Mr. Baker suggests, by making the tube on a canvas lining. Another objection to the use of india-rubber tubes soon after the operation is that if the wound is at all deep it is difficult to introduce them—a difficulty, however, which disappears as the wound consolidates. It is not to be recommended if there is excessive discharge, as it is not fitted with an inner cannula. I have lately used tubes made of a material which is called ‘coralline,’ and which is, I believe, a product of the manufacture of glycerine. It is solid when cold, and thus is as easy to introduce as a silver tube, but softens a little at the temperature of the body, and is far less irritating than the metal tube. It answered well in a case of phthisis laryngea which I had under observation for a long time.

In some cases, when the interior of the trachea is very irritable, no tube can be tolerated. In a case of this kind, in which the patient was greatly troubled with gout, I kept the wound open quite satisfactorily for a month, by dilating it twice a day with the trivalve tracheotomy dilator.

Another frequent complication is that the fluids run down from the mouth into the larynx, and so are expelled from the wound. I have already spoken of the same distressing complication after cut-throat.

It is very desirable to restore the natural respiration as early as possible after tracheotomy, and dispense with the cannula. Not only is the foreign body a constant source of irritation, but the vocal cords may get more or less consolidated together, and even in some cases the upper part of the larynx nearly obliterated. A cannula should be inserted having an opening in its convexity looking towards the glottis, through which the air can pass in expiration, and a valve applied to its mouth, so that the air can be drawn inwards in inspiration, but the valve then shuts. If it is found that this cannot be

¹ See especially Morant Baker, ‘Med.-Chir. Trans.’ vol. lx. p. 71.

² As happened to Mr. Howse's patient, ‘Med.-Chir. Trans.’ vol. lx. p. 93.

borne, and that the glottis seems obstructed, the patient should be narcotised and a bougie passed through the glottis, to break down the adhesions.

Recently it has been proposed in cases of diphtheritic obstruction of the larynx to substitute for tracheotomy the introduction of a tube through the rima glottidis, which is allowed to remain there, and through which the patient breathes. This is termed 'intubation of the larynx,' and has been extensively adopted in the United States, and to a certain extent in this country. The tubes are made in various sizes, according to the age of the patient, so as to fit the glottis, and special instruments are provided by which they can be inserted and removed. The question as to whether this plan of treatment will supersede tracheotomy must be at present considered to be undecided, but from the reports of cases in which it has been employed, it would appear to have its special difficulties and dangers. Thus it is not infrequently coughed up, and has been known to find its way into the œsophagus and be passed per anum; or it is not impossible that it might slip downwards into the trachea and require removal by tracheotomy; frequently, too, it becomes blocked with mucus or false membrane, and therefore proves inefficient. It is possible, however, that the operation may be of value in certain cases.¹

Intuba-
tion of the
larynx.

¹ For a *résumé* of our present knowledge on this subject, see a paper by Dr. Charters J. Symonds, 'Brit. Med. Journ.' Nov. 19, 1887, p. 1098.

CHAPTER XXXV.

DISEASES OF THE EAR.

THE present chapter is only intended as an indication of the chief topics in aural pathology and therapeutics; as an auxiliary to the understanding of a very difficult and complex subject, and an introduction to the study of special treatises.

The most intelligible, and, I think, for practical purposes the most useful, division of the diseases of the ear is into those of the external meatus, the membrana tympani and tympanum (including the Eustachian tube and mastoid cells), and the labyrinth. And it may be said—I think, with truth—that most of the affections of the external parts are curable, many of those of the tympanum very difficult of cure, and most of those of the labyrinth at present inaccessible to treatment.

Malforma-
tions of the
auricle.

Malformations, such as imperfect development of the external parts, absence of the meatus or supernumerary auricles, are every now and then met with. They are interesting in a scientific or morphological point of view, but of little surgical importance. Supernumerary auricles should be removed when it will improve the patient's appearance.

In cases of rudimentary meatus, surgical interference is not often desirable; chiefly because where the external division of the ear has been defective, usually the middle or internal ear has been so as well.

Hæma-
toma auris.

A collection of blood is frequently met with between the perichondrium and the cartilage of the auricle (hæmatoma auris). It is usually the result of traumatism, but may arise irrespective of injury. Formerly, owing to its frequent occurrence in the insane, it was considered to be peculiar to them. Generally it is not desirable to meddle with it, but if it threatens to grow large, a free incision must be made into the swelling, the blood-clot turned out, and the wound dressed aseptically.

Keloid and
other tu-
mours of
the auricle.

Other tumours form in the auricle, the most familiar being the little fibrous or keloid tumour which sometimes grows around the puncture of the ear-ring in ladies. When this is really increasing, or when it has attained a size which produces disagreeable deformity, it should be removed; but the operation is rarely necessary. When it is so, the best plan is to cut out the tumour by a V-shaped incision and bring the parts together at once.

Cysts, gouty deposits, and fatty or other innocent tumours are found occasionally in the auricle, but their treatment presents no peculiarity.

Eruptions.

The most common affections of the auricle are the pustular or vesicular skin-eruptions, eczema, herpes, impetigo, and the chronic inflammation which occasionally follows on erysipelas. The chief differences in the pathology and treatment of such affections from those which occur in other situations depend on the difficulty of keeping the ears clean and dry, and on the liability to accumulation of secretion in the recess of the meatus; scrupulous attention to these points will generally render these diseases much more tractable. The general health and the state of the secretions must be carefully attended

to, and the diet and medical treatment regulated accordingly. The auricle must be carefully cleansed and dried twice a day, and the meatus well syringed out with warm water or any appropriate lotion, after which the local application which is indicated in each skin-eruption is to be applied (see DISEASES OF THE SKIN). In the chronic erysipelatous inflammation lotions of nitrate of silver will be most serviceable.

The periosteum of the external meatus is sometimes inflamed, leading to an acutely painful swelling, which after some time may suppurate. It is not necessary, however, to wait for the formation of matter in order to open the swelling. A free incision will relieve the patient's sufferings, and may avert further mischief. Otherwise the bone itself may become carious; and although this disease is less alarming than that which affects the parts of the bone nearer to the vessels and membranes of the brain, yet it is tedious, threatens permanent damage to the hearing, and may spread inwards.

Periostitis
and caries
of the
external
meatus.

The examination of the external meatus is directed to ascertain the condition and appearance of its lining membrane, the presence or absence of foreign bodies, or of accumulations of wax, and the condition of the membrana tympani. In a very good light the tympanic membrane can sometimes be seen without a speculum; but usually a silver tube, either complete, or cleft and dilatable, is necessary, and unless bright daylight is available it is necessary to throw the light of a lamp with a reflector behind it down the tube. The best light is bright daylight reflected from a mirror with 8-inch focus. In operative procedures a similar mirror should be worn on the forehead (as in laryngoscopy), in order to leave both hands free. 'The points to be noted in the examination of the meatus are the size and calibre of the canal, whether normal or infringed upon; the presence or absence of extraneous bodies and cerumen, and the condition of the lining membrane.'

Examina-
tion of the
external
meatus and
membrana
tympani.

Accumulation of cerumen is a very common cause of deafness, and often induces giddiness and various still more unpleasant symptoms. It may even cause absorption of the bony walls of the meatus. The suddenness of the deafness, the presence of other catarrhal symptoms, and the variability of the power of hearing, often mark the deafness following on sudden accumulation of wax arising from catarrh of the meatus, even before examination. The wax must be removed by constant and liberal syringing with warm water. The patient sitting with his head inclined over a basin, a stream of water is to be directed out of a syringe holding about five ounces along the roof of the meatus, running out below. Softening the wax with alkaline solutions or warm oil dropped into the ears at night will promote its discharge. Often a large mass comes away at last, presenting a complete cast of the meatus, and leaving the lining of the meatus irritable. Soothing applications and repeated syringing if the wax re-collects are then required for some time. The irritability depends, in part at least, on removal of the epidermis along with the wax.

Accumula-
tion of
wax.

Another common affection of the meatus is inflammation of its lining membrane, sometimes leading to abscess. Chronic inflammation of the meatus is one cause of otorrhœa, but only one out of many; and before putting otorrhœa down to that cause the membrana tympani must be carefully inspected. If it is healthy and the disease obviously proceeds from an inflamed condition of the lining of the meatus, the next thing to determine is whether this is merely catarrhal or depends on any constitutional cachexia; of which struma and gout are the most frequent. Any such cachexia having been combated, warm syringing and warm fomentations to the inflamed membrane are indicated, with leeches and morphia if there is much pain. When the

Otorrhœa.

acute stage has subsided mild mercurial ointments, or a solution of nitrate of silver five or ten grains to the ounce, should be applied on a camel's-hair brush.

In some cases the disease becomes chronic, and the cuticular lining may desquamate from the whole meatus, like the finger of a glove. But in these instances Mr. Hinton says there is almost always disease of the deeper structures. When abscess occurs in the meatus a free and early opening is essential.

Syphilitic
affections.

Syphilitic condylomata, or secondary ulcers, may form around the meatus. They are rare, but the surgeon ought to be alive to the occurrence of such symptoms, in order to diagnose them, by the investigation of the other parts of the body and by the history.

Tumours of
the
meatus.

The tumours of the meatus are polypi, sebaceous tumours, and exostoses. Polypi usually have their seat further inwards, and will be afterwards spoken of. Sebaceous tumours also often grow into the meatus from the tympanum. Their continued growth may cause absorption of the base of the skull and fatal irritation of the brain. It is not easy to recognise them from accumulations of wax. The treatment consists in puncturing the swelling, removing the accumulation of epidermal scales by syringing, and if any distinct investing membrane can be recognised drawing it out with the forceps.

Exostoses.

These growths may be divided into two classes: (i.) a circumscribed bony tumour of the meatus which is always single (exostosis); (ii.) multiple enlargements of the canal, producing a more or less regular narrowing of the meatus (hyperostosis). They may be congenital, and then more often occur in each ear. When only one ear is affected, a local cause can often be found, and they should be considered 'rather as general enlargements of the periosteum and bone structure immediately beneath than true exostosis.' The local cause may take the form of discharge passing over the canal, or the repeated irritation of boils or small abscesses. It is certain that in a large proportion of these cases the subjects of the growths have been for many years addicted to sea-bathing. If the secretion of the ear can be removed from time to time, it is better that no more severe measures be adopted. If, however, behind the bony enlargement there is a perforation of the membrane, and the discharge cannot pass outwards, or if from the tympanic cavity a polypus arises, the life of the patient may be in jeopardy, and it becomes imperative that the growth should be removed. This may best be done by boring through the base of the growth and grinding it away by a dental-drill, which is propelled either by a machine or by electricity. The burrs used should revolve about 3,000 times per minute.

Examina-
tion of the
tym-
panum.

The membrana tympani, when seen in a healthy ear, 'reflects light strongly, and owing to its peculiar curvature presents a bright spot of triangular shape at its lower and anterior portion.' The white streak formed by the handle of the malleus can usually be seen running vertically down it.

Perfora-
tion of
membrana
tympani,
from injury
or disease.

The examination is directed to ascertain, first, the presence of perforations from injury or disease. Such perforations may be caused in a healthy membrane by a blow or a loud report, or a wound, such as is now often made in a surgical operation. These perforations may heal without damage to the hearing; or perforation may follow on the ulceration caused by a foreign body; and here also, if the perforation is not large or the ulceration long-continued, the opening may heal and the patient recover his hearing. It may be asserted broadly that the opening in the membrana tympani is in itself of subordinate importance; the injury or the inflammatory lesion of the deeper structures is what determines the presence or absence of deafness. Thus a small per-

foration which heals rapidly may yet be the cause of great loss of hearing, because along with the perforation of the membrane there has been injury of the deeper parts; nay, it is possible that the very closure of the membrane may have been deleterious, by obstructing the escape of discharge from the tympanum. An interesting account by Sir W. Dalby of accidental lesions of the membrana tympani will be found in the 6th vol. of the 'Clin. Soc. Trans.' and in the 'Lancet' for May 29, 1876. 'Out of twenty-two cases the perforation did not heal in ten; eleven healed, and one was in process of healing when last seen; in six instances the hearing did not suffer at all; in the remaining sixteen it was more or less seriously impaired.' Sir W. Dalby also points out that in cases of injury in which the membrane has not given way the hearing is generally more irreparably damaged than in those where the perforation has occurred. In one of these cases the portio dura was divided at the same time that the membrane was perforated (by a pair of scissors), causing immediate paralysis of the features.

In other cases, after more or less protracted inflammation of the membrana tympani, it gives way, either as the result of spontaneous ulceration or from some slight injury. It seems as if the patient often produces the hole in picking his ear.

In cases of inflammation of the membrana tympani the presence of red vessels on it and the loss of its natural lustre will mark the nature of the disease. I have seen very acute suffering produced by inflammation of the proper substance of the membrana tympani, which subsided and left the hearing unaffected. When this disease is acute, free local depletion, with soothing applications and the internal use of morphia, are the main points of treatment. When the disease has gone on to perforation the first thing is to get the inflamed membrane into a perfectly quiet state. The perforation may then heal. In other cases perforation depends on some of the diseases of the tympanum to be presently spoken of, especially that which follows scarlet fever.

There is not generally any difficulty in recognising a perforation of the membrana tympani. It can be seen, or a bubble of fluid is formed in it which presents a peculiar pulsation; or the patient can blow air through it by holding his nostrils, or the surgeon can inflate it through the Eustachian tube by one of the methods shortly to be described. The perforation does not necessarily produce deafness or require treatment. In fact, the loss of hearing is connected less with the destruction of the membrane than with the diseased state of the deeper parts. In the treatment of these perforations the first care of the surgeon is (as stated above) to procure the subsidence of all inflammation in the membrane, and his next to examine the tympanic cavity carefully; for the perforation is often caused or accompanied by an obstruction of the tympanum from inspissated discharge, and this must be cured by syringing out the tympanum with astringents and alkalies from the Eustachian tube and from the perforation before the latter can be got to heal. When all the neighbouring parts have been got into a healthy condition the nitrate of silver in stick or solution, or powdered talc, as recommended by Mr. Hinton, should be applied to the membrane, and some astringent or stimulating lotion dropped into the ear, so as to fill the tympanum; and then the patient should force the air freely through the Eustachian tube, allowing the lotion to escape gradually.¹

¹ Mr. Hinton prescribed the following lotions:—Hyd. Perchlor. $\frac{1}{2}$ gr., or Zinci Sulph. gr. ij.—x., or Liq. Ferri Perchlor. m x., or Tannin gr. x.—ʒi., in an ounce of water, combined in each case with from 2 to 30 drops of Tinct. Opii.

Artificial
membrana
tympani.

When all hope of the healing of a perforation is at an end, and the patient is rendered very deaf by it, the artificial membrana tympani may be tried. This is made either on Mr. Yearsley's plan, with cotton-wool moistened with glycerine,¹ or on Mr. Toynbee's, with a disc or little ball of indiarubber mounted on a stem. If the foreign substance is pressed down, either till it impinges on the perforated membrane, or in cases where the membrane is quite destroyed on the stapes and fenestra ovalis, the hearing is sometimes very materially improved. This is a matter of direct experiment; and when the artificial membrane does good the patient soon becomes much more dexterous in its application than the surgeon can be.

The other chief phenomena which are seen in the direct examination of the membrana tympani refer to its curvature and tension. Chronic inflammation causes rigidity and flattening of the membrane, which will no longer bulge outwards as the patient inflates the tympanum; or the membrane may have lost its tension altogether and hang down relaxed; or the tympanum may be filled with secretion, driving the membrane outwards and rendering it permanently curved. In cases of relaxation advantage is sometimes derived from the use of astringent lotions and from the support of the artificial membrana tympani. Cases of increased tension and of retained secretion in the tympanum must be regarded as affections of the tympanum.

Examina-
tion of the
Eustachian
tube.

The Eustachian tube is accessible from the nose, though not very readily; but an easy and very useful method of inflating this tube without any direct contact was devised some years ago by Dr. Politzer, founded on the fact that the act of swallowing opens the faucial end of the tube. All that is necessary is to pass the nozzle of an empty indiarubber syringe into the nostril, hold both nostrils, so as to prevent the escape of air, let the patient hold a mouthful of water in his mouth, and as he swallows force the air out of the syringe into his nose. The air being prevented from passing down the pharynx by its contraction will be directed against the Eustachian tube, and if the tube is unobstructed the patient will feel the air pass into the tympanum. Or the surgeon can hear it do so by placing one end of an indiarubber tube about eighteen inches long (the 'otoscope') in the patient's ear and the other in his own.

The direct examination of the Eustachian tube is made with the Eustachian catheter, a small curved catheter about six inches long. This is passed gently along the floor of the nostril till it reaches the pharynx. Then, if the surgeon is familiar with the instrument, he may apply its point to the outer wall of the pharynx and slip it directly into the tube. The more common plan is to pass it on till it reaches the back of the pharynx, then pull it forward and feel along the outer wall for the end of the tube, which lies very close to the nares. This little manœuvre becomes easy with use, and is much facilitated by practising on oneself. The catheter is known to be lodged in the tube partly by its end being caught, but chiefly by finding that the air can be blown up into the ear, or solutions injected, or flexible bougies passed up.

The Eustachian tube is subject to numerous causes of obstruction, producing what is called 'throat-deafness.' Such are thickening of the mucous membrane of the fauces, often an accompaniment of enlarged tonsils; the

¹ A small layer of cotton-wool is saturated with glycerine, and the patient is provided with a pair of forceps ending in a probe-pointed handle; with the handle he pushes the wool down the ear till he finds the place at which its lodgment assists the hearing, and the forceps enable him to withdraw it when required.

inflammatory thickening of cold, relaxation of the pharyngeal mucous membrane, tumours in the pharynx, stricture of the tube itself, and foreign bodies in it. Some of these conditions can be verified by the ordinary examination of the throat, others by posterior rhinoscopy, by which method of examination the orifice of the tube can sometimes be seen ; others only by the direct catheterisation of the tube. In cases of deafness which depend only on obstruction of the Eustachian tube the inflation of the tympanum will sometimes instantaneously restore the hearing, though only for a time. This circumstance justifies the assurance that the hearing will ultimately be regained.

When together with obstruction to the Eustachian tube there is obstruction to nasal breathing, adenoid growths must be suspected of being present in the naso-pharynx. They are simply hypertrophies of the normal adenoid tissue, and may be detected by introducing the finger into the patient's mouth and passing it behind the soft palate into the pharynx. A soft pulpy sensation is given to the finger, which is found on withdrawal to be covered with blood. They should be removed, (1) because they prevent free breathing through the nostrils, and (2) because they keep up the unhealthy condition of the pharyngeal mucous membrane, and so indirectly cause obstruction to the Eustachian orifice. In removing these growths, the patient should be anæsthetised, and the surgeon must clear the naso-pharynx either with his own finger-nail or by means of the artificial steel nail of Dalby, the flexible ring-knife of Meyer, or the forceps of Loewenberg (see page 643). As the bleeding during this operation is very free, the patient's head must be kept well forward, so as to allow the blood to escape through the nostrils ; otherwise a fatal issue may result from the blood running down into the trachea and filling the bronchial tubes.

Adenoid
growths.

Acute inflammation of the tympanum is a catarrhal affection, which produces severe pain, often extending over the whole side of the head and down the neck, aggravated by swallowing, and sometimes complicated with fever and delirium. The throat is usually also inflamed ; deafness is sometimes total. The membrana tympani may be more or less congested, and the swollen mucous membrane of the tympanum can be seen through it. If air can be blown into the tympanum it causes 'a gurgling or a prolonged creaking.' The remedies should be of a soothing nature—leeches, hot fomentations, and sedative poultices, with purgatives and opiates. The terminations of the disease are threefold—either complete resolution takes place, which is very common, or matter discharges itself down the Eustachian tube, or the membrana tympani gives way. In the two former cases the hearing is usually restored, though perhaps slowly ; nor is the perforation in the latter case by any means necessarily attended with any noticeable deafness. The remedies recommended are the constant inflation of the tympanum with steam containing the vapour of iodine or acetic ether ; passing alkaline solutions through the nose, or, if the membrana tympani is perforated, down the meatus ; and attention to the general health.

Acute in-
flammation
of the tym-
panum.

Inflammation of the tympanum leaves sometimes a moist, at others a semi-solid, effusion in the cavity, the two being probably different stages of the same process. The kind of sound produced by inflation of the tympanum will distinguish the kind of deposit in that cavity, the bubbling of the fluid being easily distinguishable from the creaking sound of dry catarrh. In the moist stage astringent injections (as sulphate of zinc) are most useful ; in the dry condition the hydrochlorate of ammonia 4 grs., or bicarbonate of soda

Moist and
dry catarrh
of the tym-
panum.

5 grs., or iodide of potassium, 3 grs. to the ounce, may be injected into the tympanum by means of an indiarubber bag attached to the Eustachian catheter; or the following plan may be adopted, as suggested by Grüber. The head being bent completely to the side to be acted upon, half a drachm of the solution is passed into the inferior naris from a glass syringe, and as the patient swallows it is forced into the tympanum with a Politzer's Bag. The injection should be practised two or three times a week.

Accumulation of mucus in the tympanum.

Accumulation of mucus in the cavity of the tympanum, probably as the result of chronic catarrh of its lining membrane, is, in Mr. Hinton's opinion, one of the most frequent causes of deafness, which, although it becomes ultimately irremediable, may be usually cured if the disease is recognised and treated early enough. This diagnosis will rest partly on the patient's sensations, partly on the phenomena above described as indicating obstruction of the tympanum, partly on the direct examination of the cavity by the Eustachian tube and meatus. The patient is often conscious himself of something moving about in his ear; the accumulated mucus may cause a bulging of the membrane into the meatus, and the moist sounds heard on forcing air into the tympanum will confirm the diagnosis. It is chiefly in these cases that the operation of incising the membrana tympani in order to wash out the cavity used to be recommended. The advantage of this procedure is not generally admitted.

Incision of the membrana tympani.

Disease of the tympanum in scarlet fever.

A very frequent cause of deafness, and an occasional cause of death, is the affection of the tympanum which follows on scarlatina. A similar affection occurs, though less commonly, after measles and whooping-cough. The mucous membrane of the tympanum becomes red and swollen, the cavity is filled with pus, the membrana tympani gives way, the ossicles are destroyed and come away, and often the walls of the cavity are diseased, leading to permanent otorrhœa. This is a common cause of incurable deafness. Generally this disease is not diagnosed till the otorrhœa calls the surgeon's attention to it. In early stages, however, it is possible, according to Mr. Hinton, to see the matter in the tympanum through the membrana tympani, and to give it exit by incision of the membrane and washing out the cavity.

Mastoid affections.

The most frequent form of mastoid disease met with is periostitis of the outer surface. Its usual mode of invasion is to travel outward from the tympanum, along the periosteal lining of the osseous meatus, until the covering of the mastoid process is reached. There will be redness and tenderness, and possibly swelling in which fluctuation is present. The treatment is the same as that of periostitis elsewhere.

Disease of the mastoid cells.

The mastoid cells may be affected with inflammation leading to caries and necrosis of their walls in cases where the tympanum appears to be unaffected. In such cases there will be inflammation, tenderness to pressure, redness and tumefaction behind the ear, and sometimes discharge from the meatus. Under these circumstances a free incision must be made upon the process, and if the bone is felt to be softened, or pus escapes from it, the tissue of the bone must be freely penetrated, and a free discharge obtained, which may preserve the patient from the risk of the transference of the inflammation to the lateral sinus or the encephalon.¹

Polypi.

Aural polypi grow either from the lining membrane of the meatus, from the outer surface of the membrana tympani, or from some part of the interior of the tympanum; and their structure is said to vary according to

¹ See Dalby in 'System of Surgery,' 3rd ed. vol. ii. p. 152; 'Med.-Chir. Trans.' vols. lxii., lxviii.; Horsley, 'Clin. Trans.' vol. xix. p. 290.

their seat of implantation. The general character of the growth is fibrous or fibrocellular, but those that are connected with the lining of the meatus are apt to contain glandular elements analogous to the glands which are found in that membrane.¹ Their more common seat, however, is the tympanum, out of which they usually grow into the meatus, destroying the membrana tympani more or less completely. They are sometimes multiple, though less often than nasal polypi are. When the tympanum is the seat of the growth the restoration of hearing must always be very problematical; but in those that spring from the meatus a favourable issue to the case may fairly be hoped. The difficulty is to eradicate the polypus finally. Its removal is not difficult, either with small ring-forceps or by means of a snare, for which purpose Mr. Hinton prefers the gimp used by anglers. When the root of the growth can be fairly exposed its removal is easy, but it is sure to grow again unless further measures are taken. The first thing is to keep the parts behind the polypus (tympanum or meatus) free from any accumulation of discharge by copious and assiduous syringing with alkaline and astringent solutions. The next essential of treatment is to repress the growth of the tumour by the constant application of caustic to its root. 'Liq. plumbi, applied by a camel's-hair brush daily for a few days before the caustic, greatly diminishes the pain. Chloro-acetic acid, potassa fusa, carefully guarded, chromic acid, or chloride of zinc, are good caustics. Nitrate of silver is excellent in the later stages. The caustic is best applied daily until a decided improvement is produced, this being by far the least painless and tedious mode of using it. At the same time a lotion of perchloride of mercury (gr. $\frac{1}{3}$ ad ζ i.), with tinct. opii \mathfrak{m} v.-x. should be used twice a day; the Eustachian tube, if closed, should be made pervious, and if the membrane be perforated a syringing from the meatus through the nostril practised frequently. When the root of the polypus shows manifest signs of disappearing we can often substitute for the caustic the undiluted liquor plumbi or the powdered talc. The time occupied in the entire procedure varies from three weeks to three or four months.'

The affections referred to the internal ear are little known in respect of their morbid anatomy, nor is their treatment at present at all successful. The diagnosis rests on the method of exclusion; that is to say, deafness for which no other cause can be found, in which the external and middle ear seem healthy, and the phenomena of hearing appear to indicate an affection of the receptive and not of the conducting media (see page 762), is judged to be due to some affection of the labyrinth or auditory nerve or cerebrum, though it often remains quite uncertain what that affection is. In some cases nervous deafness follows on mumps or on irritation of the trifacial nerve, which may be reflected to the auditory as in other cases it is to the optic nerve (page 633 *note*). In such cases the deafness will probably be only temporary. Tumours and injuries to the base of the skull may occasion deafness from direct lesion of the nerve or its roots in the brain. Hereditary syphilis sometimes occasions deafness, though I know not what is the anatomical cause. In some cases this deafness may subside under the general and local treatment suggested by the diathesis. Nervous deafness also occurs

Affections
of the in-
ternal ear.

¹ Interesting details and illustrations of the structure of aural polypi are given in Mr. Dalby's 'Lectures on Diseases of the Ear,' pp. 141-147, in which he shows that many of them approach the characters of sarcoma and myxoma, and thus the obstinate tendency to recurrence may in some cases be explained, though doubtless it is oftener a consequence of imperfect removal. The structure of recent examples of polypus is much more cellular than that of those which have been longer in growing.

from functional disturbances, mental and physical, of various kinds. It may be caused by an overdose of quinine, and cured, according to Mr. Toynbee, by the same drug in small doses. It is often accompanied by distressing tinnitus, and for such cases, as well as those which are truly neuralgic, Mr. Hinton recommends the hydrochlorate of ammonia in full doses. Finally, in old age deafness is often the sign of a loss of the sense, i.e. of permanent and irremediable degeneration of the nerve or the structures in which it terminates.

Mr. Hinton lays down the following rules for distinguishing by means of the tuning-fork whether deafness depends on obstruction in the conducting apparatus or in the receptive part of the organ of hearing. In the former case, if disease of the meatus, membrana tympani, and Eustachian tube has been excluded by the methods of examination above detailed, the obstruction must be seated in the tympanum. If it be in the receptive apparatus—the nerves or brain—no treatment, as far as is known at present, is likely to be successful. Mr. Hinton's rules are as follows. He premises—

‘That in a normal state a tuning-fork is heard before the meatus after it has ceased to be heard on the vertex. That when placed on the vertex it is heard more plainly when the external meatus is closed. Consequently, when one meatus alone is closed, the tuning-fork is heard most plainly in the closed ear.

‘The reason of this fact appears to be that the sound escapes freely through the tympanum and meatus, and that when its passage is impeded the waves are reflected and affect the labyrinth more strongly. Consequently, in cases of disease the following inferences seem justified :—

‘In cases of one-sided deafness, if the tuning-fork, when placed on the vertex, is heard most plainly in the deaf, or more deaf, ear, the cause of deafness is seated in the conducting apparatus ; if it is heard loudest in the better ear, the cause is probably in some part of the nervous apparatus.

‘If, on closing the meatus, the tuning-fork is heard decidedly louder, there is no considerable impediment to the passage of sound through the tympanum.

‘If the tuning-fork is heard longer on the vertex than when placed close before the meatus, the cause of the deafness is in the conducting media.

‘However imperfectly the tuning-fork may be heard when placed on the vertex, it gives reason for suspecting only, and is not proof of, a nerve-affection.’

I do not speak here of the congenital deafness which depends on malformation of the internal parts of the ear (deafmutism), since this affection, interesting as it has become of late, from the successful education of its victims, hardly falls within the domain of practical surgery.

In connection with nervous deafness and affections of the internal ear I ought to mention the obscure and singular affection, called after its describer ‘Menière's disease,’ in which a person previously in good health suffers from a severe attack of vertigo, sometimes so that he falls down and cannot stand for a long time, and this is accompanied by some tinnitus. On recovering from this condition one ear is found to be quite deaf. No disease can be detected in the tympanum, nor is the general health afterwards affected. ‘The nervous lesion,’ as Mr. Dalby says, ‘must be situated in the brain or the labyrinth—most likely the latter.’ An interesting paper on this subject will be found in vol. viii. of the ‘St. George's Hospital Reports’ by Dr. C. Allbutt. He gives the notes of a large number of cases in his own practice,

and asserts that the disease is neither rare nor hard to diagnose, believing that the only reason for its appearing rare is that many practitioners are not familiar with it, and so ascribe its symptoms to other causes. Dr. Allbutt follows Dr. Ferrier in believing that the essential lesion in Menière's disease is seated in the semicircular canals. Its leading symptoms, according to him, are a loss in the affected ear of the power to hear sounds transmitted through the cranial bones (not necessarily, though commonly, also deafness to aërial vibrations), giddiness, vomiting, a reeling gait, and roaring in the ears. 'It differs from cerebral disease in the greater continuance and recurrence of intense vertigo, vertigo often worse than that caused by any other malady, by the absence of loss of consciousness and by the concurrence of the vertigo with remarkable noises in the ears.' Counter-irritation, rest, and soothing remedies (chiefly the bromide of potassium) are the means generally used in treating this remarkable affection, but hitherto no effectual treatment has been introduced.

One of the most formidable characteristics of disease of the ear is its liability to produce intracranial mischief. This does not commonly occur in recent tympanic suppuration but, as a complication in cases of chronic disease of the middle ear.¹

Diseases
implicat-
ing the
brain.

The same form of disease may produce (1) general septic meningitis, (2) phlebitis of the sinuses without or with (3) pyæmia, (4) subdural abscess, (5) abscess of cerebrum, (6) abscess of cerebellum. Of these, the first three are by far the most common. The symptoms of these conditions are closely similar; there may be cessation of the otorrhœa, severe pain, rigors, followed shortly by coma and death. Tenderness in the course of the carotid sheath, together with thrombosis of the jugular vein, conjunctival congestion, and unilateral flushing of the face, would point to blocking of the lateral sinus.² If a general pyæmic affection is present, the characteristic symptoms of pyæmia will be superadded. For this class of case but little can be done, but recent advances in septic surgery have rendered it possible to operate with success in cases of localised abscess.

Abscess of the brain is probably never a primary affection, but rather a sequela of a number of totally distinct ailments. We have here only to deal with that form which follows otitis media, the cause of 40 per cent. of all cases of cerebral abscess. Intracranial abscess may occur in two ways: either (1) by a septic phlebitis which passes along the bony walls transmitting the veins, and so reaches the brain, a considerable thickness of apparently sound cortical substance intervening between the membranes and the abscess cavity; or (2) by simple extension through the bone, in which case the dura mater will be found diseased and the brain adherent to the membranes. In this form there is great danger of local septic meningitis and subdural abscess—a condition which it is difficult to diagnose from a cerebral abscess without an exploratory operation.

The most common site for a subdural abscess is close to the squamopetrosal suture over the roof of the tympanum, or on the posterior surface of the petrous bone close to the groove for the lateral sinus.³

The cerebrum is involved in 73 per cent., and the cerebellum in 27 per cent.,

¹ Ferrier and Horsley, 'Case of successful trephining for cerebral abscess.' 'Med. Soc. Proceedings,' 1888.

² Victor Horsley, 'Clin. Trans.' vol. xix. p. 290.

³ Barker, 'Brit. Med. Journ.' vol. ii. 1886, p. 1154; *ibid.* vol. i. 1887, p. 538; 'Lancet,' vol. i. 1887, p. 1175.

of cases of abscess of the brain secondary to disease of the middle ear. This proportion is accounted for by the extreme thinness of the bone forming the roof of the tympanum. The usual site of a cerebral abscess is towards the posterior part of the temporo-sphenoidal lobe, corresponding on the surface of the skull with a circle one inch in diameter, its centre being an inch and a quarter above and behind the middle of the external auditory meatus. This spot should be measured from Reid's base-line; that is, a line drawn from the lower border of the orbit through the centre of the meatus. The usual site of a cerebellar abscess is the 'outer and anterior part of the lateral lobe where it rests against the petrous bone' (Barker). The trephine to reach this must be applied below the inferior curved line of the occipital bone, about one inch from the middle line.

Symptoms. Pain is the earliest and most characteristic symptom of cerebral abscess; it is in some cases constant, in others of a neuralgic nature, and often agonising, the patient frequently holding his head firmly in both hands. The pain often corresponds closely with the situation of the abscess, and there may be a 'tender spot' on percussion over the cranium. One case, however, has been recorded in which the tender spot was found but did not correspond with the abscess. The otorrhœa has generally ceased, but foul discharge is sometimes met with; convulsions may occur, and vomiting irrespective of taking food, this latter symptom being more severe in cerebellar abscess. The pupil on the affected side may be dilated, and optic neuritis is sometimes noticed; this sign cannot, however, be relied on. Slow pulse and a subnormal temperature are frequent. In exceptional cases, 'localising' symptoms are not wanting; but too often they are absent. The grasping power of the hands should be tested, and paralysis of any group of muscles should be watched for. 'Sluggish but perfect cerebration' is, according to Gowers, a valuable sign, as seen by the deliberate slowness with which questions are answered.

Treatment. When a case is met with having any of the above symptoms the ear must be examined and thoroughly cleansed, any granulations present being removed. If the symptoms persist, the mastoid cells should be opened, and if necessary drained, and this must always be done, if only as an aid to diagnosis. If no improvement follows, the surgeon must trephine according to the directions given above. If the mastoid cells are free from disease, the probabilities are in favour of the abscess being in the cerebrum. If the surgeon fails to find the abscess there, and does not meet with any localised subdural suppuration, he should not hesitate to explore the cerebellum.

CHAPTER XXXVI.

DISEASES OF THE URINARY ORGANS.

SURGICAL AFFECTIONS OF THE KIDNEY.

ACUTE inflammation of the kidney is a very common complication in surgical cases, and occurs usually as an extension of the inflammation of the bladder, which will presently be described as the result of stricture, stone, diseased prostate, and other common surgical affections. It may also follow on injuries, or arise from exposure to cold, or from poisoning by cantharides, or alcohol. It is marked by rigors, vomiting, pain in the back, frequent scanty micturition, bloody or albuminous urine, frequently purulent, and often containing casts of the renal tubes, with a good deal of general fever. In idiopathic cases anasarca may occur, and total suppression of urine. Suppuration in the substance of the kidney may ensue, marked by increase of pain and retraction of the testicle, and is rapidly followed by the unconsciousness and sinking which attend uræmic poisoning.

Nephritis.

The passage of a calculus down the ureter—'calculous nephralgia'—is attended with some of the above symptoms. 'Indeed, excepting the severe febrile symptoms, all those of nephritis are present,' the leading symptoms being acute pain shooting down the loins, retraction of the testicle, and vomiting. The urine is scanty and often mixed with blood. The suddenness of the invasion of the disease, the comparatively healthy condition of the urine, and especially the instantaneous subsidence of the symptoms as the stone passes into the bladder, are diagnostic signs from nephritis. The treatment consists in the very free use of the hot bath, cupping and fomentations to the loins, the free administration of opium and other narcotics, and, if the pains are severe, the occasional administration of chloroform—not to total anæsthesia.

Affections
simulating
nephritis.
Calculous
nephralgia.

Acute calculous pyelitis is distinguished, according to Sir H. Thompson, from nephritis by the greater severity of the pain in the back, and the retraction of the testicle, and by the less rapid course of the disease. Blood and pus will be found in intimate admixture with the urine.

Calculous
pyelitis.

Nephritis may also be confounded with abscess from diseased spine, with lumbago or rheumatic affection of the muscles, and with hysterical or neuralgic pain; but the special symptoms of all these conditions are almost in themselves sufficient to mark the difference, and the state of the urine is a conclusive proof of the absence of nephritis.

Abscess,
rheuma-
tism, and
cystitis.

Finally, inflammation of the bladder from stone or other causes may to a great extent simulate renal inflammation, and, of course, the two are very often combined in various proportions. But the localised pain in the region of the bladder, the absence of any tenderness in the lumbar region, and the discovery of the cause of the cystitis, will distinguish it from nephritis.

The treatment of acute nephritis is directed chiefly to relieving the congested kidney by free diaphoresis from the skin, by free purging, and by leeches and counter-irritation to the loins,¹ with perfect rest and low diet. The

Treatment
of nephri-
tis.

¹ The common blister should not be used in these cases, for fear of the absorption of the cantharides. A blister can be raised at once by the strong liquor ammoniæ or by chloroform covered with a watch-glass or oiled silk.

vomiting must be combated by hydrocyanic acid or kreosote, and by mustard-poultice to the pit of the stomach. At the same time any known cause of inflammation or obstruction must if possible be removed, and as little mechanical interference with the urinary organs practised as the exigencies of the case permit.

Stone in
the kidney.

Deposits of uric acid and oxalate of lime frequently take place in the kidney, and generally the deposit passes down the ureter either as 'gravel' or as a small calculus, giving rise to the symptoms detailed above. Sometimes, however, the calculus is retained in the kidney, and, increasing in size, it at last becomes too large to permit of its passing down the ureter into the bladder. Under these circumstances it may become encysted in one of the calices of the kidney, and may give rise to no trouble whatever, so that the patient may be quite unaware of its existence. At other times it may cause a definite train of symptoms by which its presence may be recognised. These symptoms are as follows. There is pain in one loin, usually greatest at one fixed spot, but radiating from this point down the course of the ureter, into the groin and to the testicle. It is frequently increased by movement, sometimes by walking, sometimes by riding. It is also increased by pressure over the region of the kidney. The urine generally contains a small amount of blood and pus, and frequently crystals of oxalate of lime or lithic acid, according to the diathesis of the patient. The blood is often slight in amount, possibly only to be recognised by the microscope; sometimes, however, there will be a history of the passage of blood in sufficient quantities to be recognised by the patient. The amount is often increased by exercise, and especially by manipulation of the kidney. After a medical examination, for instance, in which the kidney has been carefully explored in order to ascertain whether any stone is to be felt, the patient may notice an increased quantity of blood in the water. The urine is generally acid and contains a small amount of pus, due to a certain degree of inflammation set up by the presence of a foreign body. There is frequently an irritability of the bladder, the patient desiring to pass water very constantly; and from this circumstance, and from the hæmaturia, these cases have been liable to be mistaken for stone in the bladder. Occasionally, if the stone has attained any size, and the patient is thin, it may be felt through the abdominal wall by a bimanual examination; the one hand making firm pressure and pushing forwards the kidney from the loin.

The palliative treatment of calculus in the kidney comes rather within the province of works on medicine. The surgeon, however, is often consulted as to the advisability of removing a stone from the kidney. And when the symptoms are severe and are not ameliorated by medical treatment, and when the inconvenience caused is so great as to interfere with the employments or enjoyments of life, the operation of nephro-lithotomy is indicated, provided the patient is otherwise in good health and is not habitually passing gravel, and the tendency to do so cannot be removed by medicinal treatment.

Nephro-
lithotomy.

The operation of cutting into the kidney for the extraction of a calculus—nephro-lithotomy—is performed as follows. The patient is placed on the opposite side to that on which the operation is to be performed, with a pillow under his loins, as in the operation for lumbar colotomy. Various incisions, vertical, oblique, and transverse, have been recommended for exposing the kidney. Probably the best are either an oblique one parallel with and three-quarters of an inch below the last rib, or a slightly more transverse one from the tip of the last rib, carried backwards to the edge of the erector spinæ, so

that its posterior extremity is about three-quarters of an inch to an inch below the rib. This latter incision appears to give the best access to the kidney, especially its upper part, and by making it not quite parallel to the last rib, but diverging from it a little behind, the risk of wounding the pleura is avoided. If there should not appear to be sufficient room, it may be converted into a T-shaped incision by a second cut downwards from the centre of the first to the crest of the ilium. This, however, is rarely necessary in nephro-lithotomy, though often requisite in nephrectomy. The various layers having been divided, the transversalis fascia is reached and divided, and the peri-nephritic fat exposed. This is carefully torn asunder with the fingers, keeping to the back part of the wound over the quadratus lumborum muscle, and the kidney exposed. The forefinger is then carefully passed over the whole of the surfaces of the kidney, and any inequality of surface or any undue prominence or hardness noted. It is useful, in this exploration, to pass one forefinger in front and the other behind the kidney, and compress the organ between the two digits; and the neighbourhood of the pelvis should be especially examined. If any hardness or inequality of surface is detected, a smooth round needle mounted on a handle is to be introduced, and if a stone is present the point will be felt to grate upon it. Otherwise the kidney is to be methodically explored with the needle until it impinges on the stone. Or should it not do so, and the symptoms of renal calculus are well marked, it may be justifiable to make an incision into the cortex of the kidney and endeavour to feel the stone through the wound with the finger. Cases are on record where such an incision has relieved the patient though no stone has been detected. The calculus having been felt by the needle, an incision is to be made in the cortex of the organ, guided by the needle, down on to the stone. This is usually followed by a profuse gush of blood, which is, however, generally speedily arrested by pressure. A pair of dressing forceps are now introduced through the wound in the kidney thus made, and the structure of the organ torn through by dilating the blades to a sufficient extent to expose the stone thoroughly. With a pair of ordinary bullet forceps, or with a small scoop, it is generally now perfectly easy to extract the stone. In incising the kidney, it is better to cut through the structure of the organ than to attempt to open the fibrous tissue of the pelvis or expanded upper end of the ureter; though in cases where the stone is lodged in this situation this, of course, must of necessity be done. Wounds of the kidney structure heal much more readily and have less tendency to form a fistula than wounds of the fibrous structures forming the commencement of the ureter. After the calculus has been removed the kidney must be carefully explored in search of any second stone which may exist. After the operation a large drainage tube must be inserted and the external wound closed with sutures. It must be dressed with some antiseptic dressing, outside which must be placed a thick pad of absorbent material, which will require frequent changing.

In cases in which on exposing the kidney it is found to be completely filled with calculi, and its secreting structure entirely destroyed, it will be better at once to proceed to the operation of nephrectomy. But in cases where a condition of pyo-nephrosis has been set up as a result of calculous pyelitis—that is to say, where the kidney has been converted into a multilocular sac, filled with pus—the general opinion seems to be that it is better to simply lay open the kidney, provide for antiseptic drainage, and defer the graver operation for some months, when it is clear that the simpler proceeding of draining the cavity will not affect a cure.

Nephrectomy.

Complete extirpation of one kidney is now an established operation in surgery, and is frequently performed, and with a very large proportion of success. The conditions under which nephrectomy has been undertaken are for movable kidney accompanied with much pain; for old scrofulous disease exhausting the patient by constant discharge; for calculus; for hydro- or pyo-nephrosis, from whatever cause arising; for tumour; or for injury to the organ or its excretory duct. In cases of tumour of the kidney, as the disease is usually of a malignant nature, the operation is less clearly justifiable than in the other classes of cases; but we are scarcely in a position yet to definitely decide as to the choice of cases in which this procedure should be adopted.

The kidney may either be removed by a free incision from the loin or by abdominal section through the peritoneal cavity. The chief objection to the former operation is that the condition of the other kidney cannot be ascertained by direct examination; and in addition to this the space in which the surgeon has to work is very limited, and there is often great difficulty in reaching and freely exposing the pedicle. Still I have no doubt that this operation is to be preferred whenever the mass is not so large as to render it impossible to obtain thus a free access to the pedicle. In the abdominal operation the peritoneal cavity is opened,¹ and there is great difficulty in keeping it free from contamination. Moreover, the difficulties of drainage and the tendency to ventral hernia afterwards are greater than in the lumbar operation.

The earlier steps of the operation in lumbar nephrectomy are the same as those for lumbar nephrotomy. It is usually necessary in these cases to make a second vertical incision from the centre of the first to the crest of the ilium. After the kidney is exposed the further proceeding will depend upon the cause for which the operation has been undertaken. If there has been peri-renal inflammation, as in cases of scrofulous or calculous pyo-nephrosis, it will be necessary to open the capsule and enucleate the organ from it. In other cases the capsule should be removed uninjured if possible. The kidney, with or without the capsule, is then carefully enucleated from all its surroundings until it can be felt to be attached only by its pedicle. An aneurism needle, armed with a double ligature, is now passed between the vessels and the ureter. It is then divided and one half tied round the vessels and the other round the ureter. These ligatures are to be placed on their respective vessels as far from the kidney as possible, so as to leave plenty of room for the division of the pedicle. The kidney is now drawn well out of the wound and cut off with a pair of scissors. A large drainage tube is inserted, the wound closed and dressed with some form of antiseptic dressing. Abdominal nephrectomy may be performed by an incision in the linea alba or in the linea semilunaris. This latter incision, recommended by Langenbeck, is almost universally adopted. The operation is to be performed with all the precautions usually taken in abdominal section, and every care must be taken to prevent contamination of the peritoneum, either by the urine or the contents of the tumour in hydro- or pyo-nephrosis.

The peritoneum having been opened, the layer of serous membrane passing from the colon to the abdominal wall is to be carefully divided, and the peri-nephritic fat torn through until the surface of the kidney is exposed. It is then to be gently enucleated and the pedicle isolated. The vessels are

¹ On one occasion I removed a kidney by abdominal section behind the peritoneum, by an incision very similar to that which Murray and Monteiro employed to ligature the abdominal aorta.

to be secured in the same way as in the lumbar operation. But the ureter must be tied in two places, and divided between, great care being taken that no urine escapes from it into the peritoneal cavity. The operation is then completed as after ovariectomy, the wound closed in the usual way, and dressed with all antiseptic precautions.

The chief point in the after-treatment is to endeavour to keep the skin acting as freely as possible, so as to relieve the one kidney, which now has to do the work of two. The room should be kept warm and the air moist, and the patient should be covered up in blankets, as warmly as may be.

In some cases of movable kidney, accompanied by considerable pain, but by no degeneration of the kidney, the symptoms have been relieved by cutting down on the kidney from the loin, drawing it back into position, and fixing it in the wound by sutures passed either through the peri-renal fat, or, better, through the capsule of the kidney—an operation to which the name of nephroraphy has been given. The operation is only suitable to those cases where the kidney has not become invested in a sac of peritoneum, as sometimes happens, and to which the term 'floating' kidney is often applied in contradistinction to the 'movable' kidney, where the organ simply slips about in the loose perinephral fat. In these latter cases the operation appears to be unattended with any danger, and the worst that can be said against it is that it is not always successful.

Nephro-
raphy.

Chronic nephritis, as a sequel of the acute and the other conditions which lead to albuminuria, or Bright's disease, would form a subject too extensive and too purely medical for the present place. I will content myself with saying that in all surgical cases the state of the urine should be carefully examined, and the surgeon should be familiar with the signs of chronic degeneration of the kidney, since they powerfully influence prognosis, and will often contra-indicate operations and other active treatment in diseases where such treatment would otherwise be pressed upon the patient.

Chronic
nephritis.

The passage of blood in the urine is a frequent symptom both in medical and surgical practice; and although the treatment of many of the conditions which give rise to it lies within the province of the physician, yet it is necessary to review all of them for the purpose of diagnosis.

Hæma-
turia.

The blood may come (1) from the kidney, including the ureter; (2) from the bladder, including the prostate gland; (3) from the urethra.

1. The sources of renal hæmorrhage are contusion or laceration of the kidney by a blow or fall; cancer of the kidney, and possibly other tumours; congestion from nephritis or from the use of certain drugs; the irritation of a calculus, either in the kidney or ureter; to which may be added that in some general diseases, such as purpura, the hæmorrhagic diathesis, scurvy, and as a sequel of eruption or continued fevers, blood passes from the kidneys. Hæmaturia also occurs in some localities in consequence of the presence in the pelvis of the kidney of a minute parasite, the *Bilharzia hæmatobia*, or of the presence in the blood of the *Filaria sanguinis hominis*.

The diagnostic symptoms of such of these affections as lie within the province of surgery will be found under their appropriate headings, to which I will only add that the blood from the kidneys is always intimately mixed with the urine (giving it a dark porter-colour), and that 'as a general rule such urine, passed without pain or any other local symptom whatever, is more likely to derive its blood from the kidney than elsewhere' (Sir H. Thompson).

The urine should be carefully examined microscopically in order to determine the presence or absence of casts of the kidney-tubes.

2. The sources of vesical hæmaturia are—wound of the bladder or prostate; tumour, cancerous or villous; calculus in the bladder; congestion of the prostate gland; ulceration of the coats of the bladder or acute congestion in cystitis.

Blood from the bladder is generally less intimately mixed with the urine than that from the kidney; it very commonly clots in the bladder and remains behind after the urine has been passed; the urine first passed is often comparatively clear, while at the end of micturition the blood is passed almost or quite pure. But these signs are not always to be implicitly relied on, and the surgeon must examine the patient carefully for the diagnostic symptoms of the affections above enumerated.

3. Urethral hæmorrhage is caused by blows or wounds (including laceration by the catheter), impacted calculus, rupture of the corpus spongiosum in sexual intercourse or chordee; tumours in the urethra; ulceration, chiefly in syphilis; congestion in gonorrhœa or stricture.

The most reliable test of this source of hæmorrhage is when it can be detected as occurring independently of micturition, which can almost always be done if the patient be carefully watched, or when the blood collects in the urethra and forms a cast of it.

The source of hæmorrhage and its supposed cause, being determined, the treatment of the latter is, of course, the main indication; but the hæmorrhage itself sometimes requires treatment. The bladder may be so abundantly occupied by clot as to require its disintegration and removal piecemeal, by means of the injecting catheter; the amount of blood from the kidney may be so alarming as to demand the administration of internal styptics; urethral hæmorrhage may sometimes be controlled by pressure, a metal catheter having first been passed; and perfect rest should in all cases be enforced whenever the bleeding is considerable.

Suppression of urine.

Suppression of urine is an event which is almost certainly fatal, and which must be carefully distinguished from retention. Obvious as this distinction is, it is strange how often the mistake is still made. The causes of suppression are general, while those of retention are local. In suppression the bladder is found perfectly empty on passing a catheter, or almost so; the patient experiences no difficulty in passing water, but has none to pass, or only a very small quantity. He is troubled with vomiting, and generally pain in the back, and is feverish; becomes stupid, perhaps delirious, and then comatose, and almost always dies. Sir H. Thompson mentions a case in which the patient recovered after forty-eight hours of complete suppression, and I have known another similar one. The chief points in the treatment are free action on the skin by the hot bath and vapour-bath, fomentations and leeches to the back, and free purgation.

DISEASES OF THE BLADDER.

Malformations.

THE bladder has been absent, the ureters opening into the urethra, rectum, or vagina, but the malformation is a very rare one.

Congenital cyst.

Less uncommon is the presence of a 'double bladder,' or large congenital cyst, of which a remarkable instance, shown in Fig. 355, occurred in my own practice. Such cases cannot be diagnosed or treated during life. Their main interest consists in knowing that such a diverticulum may occur, and

may very easily become the seat of a calculus, which then would present great difficulties in its operative treatment.

The ordinary malformation of the bladder, however, is *extroversion*. This condition depends on a malformation of the abdominal parietes. In most cases the whole of the hypogastric region is deficient, from the navel to the pubes. There is no umbilicus; the anterior wall of the bladder is also deficient: its posterior wall is attached to the skin, and projects from the belly in the form of a red prominence, bleeding readily, and showing the slit-like mouths of the ureters, from which the urine can be seen distilling. The parietes extend, however, in some cases lower than the umbilicus, which is then natural. Bounding the extroverted bladder is a double ridge, like a V inverted, which marks the coalescence of the skin and bladder. The penis is rudimentary, and is marked by a groove on its dorsal aspect, into the back of which as it joins the vesical membrane the semen is discharged in adult life. The prostate is hardly to be discerned. The testicles are generally natural. There is often hernia on one or both sides. The pubic symphysis is often deficient.

Extroversion.



FIG. 355. Malformation of the bladder, showing a large cyst, or false bladder, which communicated with the true bladder. The parts were taken from a male infant, who was born with retained testicles and a peculiar shape of the abdomen, the parietes of which were deficient below, so that the viscera protruded beneath the skin. There was a naevus on the skin of the pubes. The child thrived for a few days, then began to refuse the breast, passed blood in the water, and died on the eighth day. *a*, the bladder with the large cyst lying above it. This was the true bladder; its walls were much hypertrophied, and its interior covered with naevus tissue, from which, doubtless, the bleeding had come. The openings of the ureters and urethra were quite natural. *b*, a rod passed into the secondary cyst, the walls of which were very thin and destitute of muscle. It showed no trace of any vascular tissue on its interior. It lay in the right side of the pelvis and right iliac fossa. Death had evidently been caused by its pressure on the ureters. The kidneys, *c*, *d*, are seen to be much dilated and absorbed by pressure, especially the left, and the ureters were dilated and tortuous. The testicles lay close below the kidneys.—'Path. Soc. Trans.' vol. xvi. p. 169; St. George's Hospital Museum, Ser. xii. No. 115.

The same malformation occurs in the female sex also, but much more rarely.¹ It is not necessarily complicated with any malformation of the internal sexual organs, and women so afflicted have borne children.

The malformation is perfectly consistent with health, and I have often seen vigorous adults affected by it. Its inconveniences are the constant dribbling of urine and the tendency of the exposed membrane to bleed. The latter infirmity may be corrected by a plastic operation, which was first successfully performed in this country by me in the year 1863,² and a similar

proceeding has been successfully repeated by Mr. J. Wood and other surgeons. It consists in bringing two skin flaps over the bladder, one turned with its

¹ See a paper by Dr. Champneys on 'Extroversion of the Bladder in the Female' in 'St. Barth.'s Hosp. Reports,' vol. xiii. See also an extraordinary case, described in the 'Gaz. des Hôp.' July 21, 1877, in which the vagina was entirely absent, and the uterus opened externally.

² 'Lancet,' 1863, vol. i. p. 714.

cutaneous surface downwards, so as to be in contact with the extroverted mucous membrane; the other with its raw surface downwards and in contact with the raw surface of the former. These, being united to each other, form a thick bridge over the cleft, which may be afterwards implanted into the skin of the abdomen till only a narrow orifice is left below, to which a bottle can easily be applied. But the patient or his friends must be instructed to wash out the cavity frequently with acidulated water, to prevent the formation of phosphatic concretions. Attempts have been made to divert the course of the ureters into the rectum so as to form a cloaca there and obviate any incontinence of urine, but these have not hitherto been followed by any large amount of success.

Inversion
of the
bladder.

In connection with malformations I may mention the inversion of the female bladder which is sometimes met with in childhood, and which, though not due to malformation, might easily be mistaken for it. It seems to occur from constant straining in making water. The bladder projects through the urethra, as a pyriform red vascular tumour in which the orifices of the ureters can be seen. On a careless examination this might be mistaken for extroversion, or still more fatally for a polypus, and it has nearly been tied on that suspicion. Treatment by careful reduction, maintained by a catheter with a bulbous end, and frequent cauterisation of the expanded urethra with the actual cautery, has been successful in restoring the power of retaining the urine.¹

Hernia
of the
bladder.

The bladder may protrude as a hernia into the scrotum or vagina, or may form part of the contents of an inguinal hernia in the male, or a femoral in the female. The occurrence is a rare one, the diagnosis difficult, and in one case recorded by Pott the herniated bladder was opened by mistake. When, by careful examination, the surgeon has reason to apprehend that the bladder is herniated—i.e. when pressure on the hernia always causes the immediate exit of urine, and when a catheter passes into or towards the hernial orifice—double care should be exercised to reduce it and keep it reduced. In the female, when it protrudes into the vagina it constitutes one of the forms of vaginal cystocele, which will be found treated of in a subsequent chapter.

Tumours
of the
bladder.

Many kinds of tumour have been found springing from the walls of the bladder. The innocent tumours are the simple mucous polypus, the fibrous, the myoma, the dermoid tumour, and the villous papilloma. Of these the villous papilloma is of all growths that which most frequently affects the bladder; the others being so rare as to require no more than a passing mention. The simple mucous polypus is occasionally found in the bladder, but only hitherto in that of the young child. Springing from the mucous-membrane, it resembles in structure the ordinary gelatinous polypus occurring so frequently in the nose. The fibrous tumour of the bladder is a solid growth, often attaining a considerable size, and consisting of connective tissue, but frequently presenting a small amount of fimbriated papillæ on its surface, as indeed all vesical tumours have a tendency to do (Fig. 356). The myoma are outgrowths of the contractile coat of the bladder, consisting of organic muscular fibre, forming small, firm tumours, rounded in form, springing from a wide base, and not, as a rule, attaining a large size. The dermoid tumour is the rarest of all vesical tumours. The villous tumour of the bladder, or papilloma, is an innocent growth, though it may cause death from hæmorrhage. It consists of numerous processes, exactly resembling the villi of the chorion,

¹ Lowe, in 'Lancet,' 1862, vol. i. p. 250.

which when immersed in water float out, presenting long, slender, filamentous threads, each consisting of a capillary loop, surrounded by a delicate connective tissue, and covered by epithelium similar to that lining the bladder (Fig. 357). They are very vascular, and often developed at different parts of the bladder so as to form multiple growths. Malignant tumours of the bladder are generally epitheliomatous; squamous epithelioma not unfrequently attacking this organ as a primary growth, and generally commencing on the posterior wall of the organ. It rapidly infiltrates the coats of the bladder, and, ulcerating, produces a ragged surface on which phosphatic deposit speedily encrusts. Scirrhus is also said to attack the bladder as a primary



FIG. 356. A mass of malignant disease, growing out of a cyst on one side of the bladder, and projecting to a certain extent into its cavity. Its outward appearance is exactly that of villous tumour, and it is only on microscopic examination that the difference is perceived. The disease had existed for many years, and at times occasioned hæmorrhage, the source of which could not be detected.—From the Museum of St. George's Hospital, Ser. xii. No. 24.



FIG. 357. Villous tumour of the bladder, from a patient æt. eighty-one, who had suffered from attacks of hæmaturia occasionally for twenty years. The mass of the growth is seen to be connected with the neck of the bladder. A portion, consolidated by coagulum, so as to resemble a soft calculus, was found loose in the bladder, and is represented in the corner of the figure. The patient had exhibited no dangerous symptoms till shortly before his death, as the hæmaturia had yielded to astringents. But a week before his death complete retention of urine came on, requiring the use of the catheter, and a small portion of the growth came away in the eye of the instrument, which on microscopical examination revealed the nature of the disease.—From a preparation in the Museum of St. George's Hospital, Ser. xii. No. 113.

growth, but much more rarely than epithelioma. Probably in many of these cases the primary deposit is in the prostate, from which it extends to the bladder. Finally, sarcoma is occasionally found in the bladder of children, though rarely in the adult. It may be either of the spindle-celled or round-celled variety.

The symptoms of tumour in the bladder are irritability of the organ and hæmaturia. At first there is merely increased frequency in micturition, which may excite no suspicion. This is followed by a copious flow of blood, possibly without any appreciable cause. The blood is not uniformly mixed with the urine, but comes chiefly towards the end of the act of micturition, and sometimes flows away almost pure after the urine has ceased to pass. After a short time the bleeding ceases, but may return irregularly, with

long intermissions of health. Usually the hæmorrhage is unaccompanied by pain, but sometimes severe pain is complained of.

This would appear to depend upon the situation of the growth. When a tumour is growing near the neck of the bladder and is tightly grasped by its muscular fibres during each action of the bladder, the pain is often very considerable; whilst a tumour might exist in the fundus or upper part of the bladder without giving rise to any symptoms at all. The same remark applies to obstruction to the flow of urine, which may amount to retention if the tumour is situated at the neck of the bladder; whereas a growth at the upper part of the organ would present no obstacle to the exit of the urine. Obstruction to the outflow of urine is nevertheless sometimes occasioned in cases of tumour of the bladder growing from any part of the viscus, by the formation of clots, which obstruct the urethra, and which very commonly form in this variety of vesical hæmorrhage.

Such symptoms as these will always arouse the suspicion of a tumour of the bladder. And the diagnosis will rest on (*a*) exclusion of the other sources of hæmaturia, (*b*) on detection of portions of the growth in the urine, and (*c*) on direct examination.

Reference may be made to the section on Hæmaturia (p. 769) for the symptoms attending the various forms of bleeding from the urethra. From calculus, tumour may be distinguished by the less abundant hæmorrhage and the less amount of pain and irritation of the bladder, and by the passage of a sound failing to detect a stone. Little information will be gained by sounding as to the actual presence of a tumour.

Possibly a little irregularity may be felt, and the operation will probably be followed by a profuse hæmaturia. Prostatic hæmorrhage sometimes gives rise to a suspicion of tumour; but the transient character of this affection will distinguish it, at any rate, from the hæmaturia due to malignant disease. The most important and characteristic sign by which the presence of the most common growth, villous tumour, may be infallibly diagnosed is the presence of portions of the growth in the urine, and in cases of suspected tumour of the bladder they should be persistently sought for. If the disease is papilloma, portions of the growth not unfrequently become detached, especially during sounding, and a careful microscopic examination will generally succeed in discovering them. Or, it may be, some fragment may become caught in the eye of the catheter, which in these cases should always be used in preference to a sound for exploration, and may thus be extracted and the true nature of the disease rendered certain by microscopic examination.

Examination by the rectum does not afford much information as regards the villous growth, but, on the other hand, affords the most conclusive evidence of the existence of cancerous disease of the bladder. If this condition exists, on introducing the finger into the rectum a well-defined mass of hard unyielding consistence will be felt; and if, as sometimes happens, the malignant tumour fills the bladder almost entirely (Fig. 358), it may be recognised by firmly pressing above the pubes at the same time.

Finally, if the history and symptoms point to tumour of the bladder, but the absence of portions of the growth, after repeated examinations, from the urine does not point certainly to the presence of villous tumour, and the examination by the rectum and general condition of the patient seems to negative the probability of malignant disease, it is justifiable to make a direct examination through a small opening in the perinæum. By this means the surgeon at once determines the presence or absence of the growth, and is also able to

ascertain its exact position and attachments, and whether any attempt should be made for its removal.

Until recently the treatment of tumours of the bladder has been mainly palliative, i.e. directed to subdue pain by opiates and to check hæmorrhage by astringents. Sir H. Thompson has, however, lately recommended and extensively practised the removal of innocent tumours, and a very gratifying amount of success has been obtained. If the nature of the growth is uncertain, he makes a free incision into the urethra in the middle line of the perinæum, along which the finger is passed through the prostate and neck of the bladder into its cavity. Being empty, the whole interior of the bladder can be examined by the finger, aided by counter-pressure above the pubes, and the exact nature and attachments of the tumour ascertained. If the growth is found to infiltrate the coats of the bladder and to be probably of a malignant nature, or at all events not admitting of removal, no further operative measures are had recourse to. If it is a single pedunculated growth, the neck of which can be easily grasped with the for-

ceps, it is at once seized with appropriately shaped forceps and twisted off. If, however, the extent of attachment of the tumour is considerable, and there appears to be any difficulty in removing it, Sir H. Thompson at once proceeds to open the bladder above the pubes and remove the tumour with blunt or cutting forceps, according to the nature of the tissue to be removed, using the sharp instrument only when it is not possible to remove the growth with the blunt one.

In cases where the nature of the growth is rendered certain by the presence of some

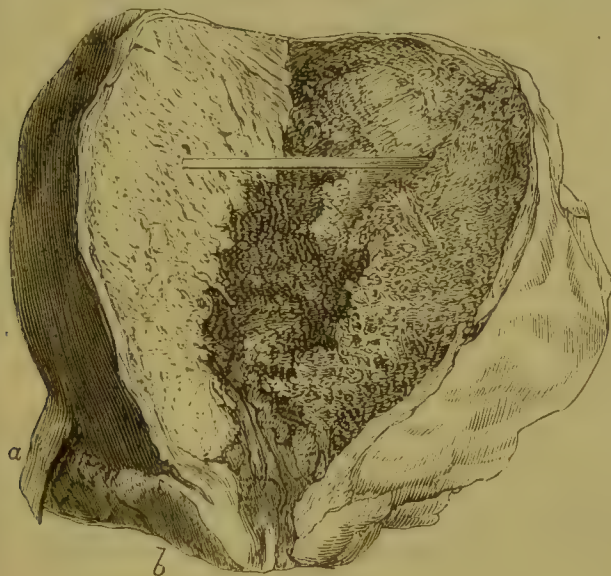


FIG. 358. Malignant disease, nearly filling the cavity of the bladder; *a* points to the ureter, which is somewhat dilated; *b* shows the urethra and prostate quite unaffected; the disease being limited to the cavity of the bladder.—St. George's Hospital Museum, Ser. xii. No. 26.

of its fragments in the urine, Sir H. Thompson dispenses with the preliminary exploratory incision in the perinæum, but proceeds at once to open the bladder above the pubes and to extract the tumour by this route.¹ The operation differs in no respect from the ordinary suprapubic lithotomy, hereafter to be described.

Inflammation of the bladder is divided into three degrees—acute, subacute, and chronic. Most of the cases which are seen in surgical practice belong to the subacute or the chronic variety. The causes are usually those which produce obstruction to the flow of water or direct irritation of the mucous membrane. Thus cystitis is a frequent, or even constant, complication of stricture and enlarged prostate; it is one of the symptoms of stone or other foreign body in the bladder, and is very liable to be caused by the retention of a catheter in the bladder. Fractured spine usually produces cystitis, and

¹ See a clinical lecture by Sir H. Thompson, 'Brit. Med. Journ.' vol. i. 1888, pp. 1 and 57.

cystitis is often produced by the irritation from decomposing urine in other forms of paralysis where the patient is unable to pass water. Some materials which are eliminated by the urine out of the blood, having been taken as food or absorbed from the skin, may cause cystitis. The familiar example of this is the inflammation of the bladder sometimes produced by cantharides taken into the stomach or applied as a blister. The bladder may also be inflamed by the spread of inflammation from a neighbouring organ, as in gonorrhœa or in inflammation of the prostate. Finally, direct mechanical violence, as in surgical operations, is a frequent cause of cystitis, or it may originate spontaneously, either from exposure to cold, or from tubercular irritation or the softening of tubercular deposit, or without any assignable cause.

Anatomy
of cystitis.

Inflammation of the bladder commences always on its mucous surface, the membrane becoming so loaded with blood as to assume a dark purple colour, thickened and velvety, in some cases coated with adherent lymph and phosphatic deposit from the urine, in others ulcerated here and there. The irritation which accompanies it produces frequent and spasmodic muscular action. Often the cause of the affection involves obstruction, and consequently much straining to make water, and from these circumstances muscular hypertrophy is a constant phenomenon in cystitis, so that the muscular fibres stand out under the mucous surface somewhat like the columnæ carneæ of the heart, and they cross each other in every direction, leaving small spaces or alveoli between them. To this condition the terms 'columnar' or 'fasciculated' bladder are applied. The mucous coat of the bladder is often protruded through the opening of these fasciculi, causing pouches which sometimes do not reach through the whole thickness of the walls of the bladder (Fig. 391), while at other times they form distinct and definite projections (Fig. 392), often of very large size. Similar and sometimes much larger pouches or cysts are found, as congenital malformations (Fig. 355).

The symptoms of cystitis in the acute form are general fever, great pain in making water, frequency in micturition, bloody urine, soon turning purulent, pain and tenderness to pressure in the region of the bladder, and pain extending down the thigh and perinæum; often also the straining produces prolapsus or piles.

Formation
of ropy
mucus.

We commonly see, however, the less severe form, which is variously described as subacute or chronic, in which the mucous membrane of the bladder secretes an abundant deposit of alkaline mucus or muco-pus, and in which the urine is turbid and contains a variable quantity of a mortary deposit, usually called 'ropy mucus.' This deposit is formed of phosphate of lime mixed with pus and mucus, and is very viscid, clinging to the vessel when inverted and slowly falling out in a mass. The supernatant urine, when examined by the microscope, usually is found to contain a good deal of pus, and the triple phosphate of ammonia and magnesia. This phosphate is also sometimes found mixed with the phosphate of lime in the sediment. The urine decomposes, becoming intensely alkaline and ammoniacal; whereas when the mucus is only in small quantity, though the deposit is itself alkaline, the urine may be acid.¹ The essential cause of the alkalinity of the urine is the decomposition of the urea and its conversion into ammonium carbonate. What gives rise to this decomposition is not very clear, but it is generally believed to be due to a process of fermentation, in which the ferment which starts the process is admitted from without. At all events, in urine which is undergoing ammoniacal decomposition, micro-organisms are invari-

¹ Sir B. Brodie's Works, vol. ii. p. 466.

ably found; and it is quite conceivable that these may have gained access to the bladder either by means of catheters introduced for the treatment of the affection which gave rise in the first instance to the inflammation, or by means of the mucus which remains in the urethra after the passage of urine loaded with this tenacious material, and which forms a channel of communication between the bladder and the external air. The ammoniacal urine acts as an irritant on the bladder and propagates the inflammatory condition by which it was caused. The inflammation may even spread up the ureters to the pelvis of the kidney, exciting inflammation of its lining membrane; in which case the urine will be secreted alkaline, and earthy phosphates may be found on the renal calices; sometimes the inflammation causes the formation of small abscesses beneath the lining membrane of the kidney—a condition to which the term pyelitis is applied.

Other changes occur also in the bladder besides the ordinary morbid phenomena above described. Generally speaking, the inflammation produces only muscular hypertrophy, accompanied by no permanent change of the mucous membrane; but in some cases organised inflammatory or fibroid deposit may be found in the submucous coat. At other times deposits of pus (abscess of the bladder) occur in the thickness of its walls; and there are cases (though chiefly in stone or foreign body) where the mucous coat is ulcerated, or even where ulceration extends through the whole bladder and produces perforation. This ulceration is usually marked by vesical hæmorrhage and by acute localised agony in the part affected, much aggravated by the contact of instruments. I remember meeting with it once in a case of stone, where it persisted long after the removal of the calculus (which was a very small one) by a single sitting of lithotrity, and ultimately proved fatal by pyæmia.

In these cases of cystitis with hypertrophy the cavity of the bladder is usually contracted, and often very much so. But there are many cases of passive obstruction in which, on the contrary, the bladder is simply distended and much thinned. ‘This condition occurs not in stricture, but in those cases of enlarged prostate where, by reason of the size of the prostatic mass implicating the muscular apparatus at the neck of the bladder, the viscus is incapacitated from contracting and suffers passive distension.’—Thompson.

Contraction and dilatation of the bladder.

The treatment of cystitis, like that of all surgical affections, to be rational and successful, must be guided by a knowledge of its cause. In the rare cases where no cause can be ascertained, the treatment must be directed to soothing irritation and removing pain. For these purposes rest in the horizontal posture, warm fomentations, warm hip-baths, and opiates by the mouth or as suppositories, are very useful. In acute or subacute cases the application of leeches or cupping the perinæum is extremely beneficial. The bowels are to be kept open without purging. Hyoscyamus in large doses is often of great service. The other medical means must be regulated by the acuteness of the attack and the condition of the urine. If the latter be acid and the attack moderately acute, the urine should be neutralised by giving the alkaline carbonates and diluted by the free administration of mucilaginous drinks, barley-water, &c.

Treatment.

But in ordinary cases the attack is not acute, nor is there any doubt about its cause. The presence of a stricture, an enlarged prostate, a stone, a gonorrhœa, or an injury of the spine, at once points out that the cystitis is but a symptom, and that its cure must depend on the surgeon's success in removing the cause on which it depends.

If this can be done, even if the urine is ammoniacal the bladder will speedily recover itself; but when this is impossible, much, as Sir B. Brodie remarks, may be done towards relieving the condition. In cases which are simply the sequel of an acute cystitis, and in which no decomposition has taken place, and the urine is not foul and loaded with ropy mucus, treatment by warmth and rest, the exhibition of diluent or demulcent draughts in tolerably large quantities, with alkalies and henbane, will generally be followed by marked improvement. But when decomposition of the urine has taken place and a condition of catarrh of the bladder has been set up, accompanied by copious secretion of ropy mucus, no treatment will be of any avail until this condition has been corrected. Under these circumstances the bladder must be washed out night and morning with some antiseptic solution until the putrefactive changes have been overcome. Amongst the most useful of these antiseptic injections is boracic acid, either as a concentrated solution or in combination with glycerine (boroglyceride ʒij. , aquæ Oss.). Condyl's fluid (ʒj. to Oj.) is also especially useful. Quinine (gr. ij. to ʒj.), iodoform in the same proportions, and solution of corrosive sublimate (gr. $\frac{1}{4}$ to ʒj.) have also been largely recommended. One of these antiseptic solutions is to be injected in small quantities, say a couple of ounces at a time, until it returns perfectly clear; that is to say, a soft rubber catheter is to be introduced and the urine drawn off; a couple of ounces of the antiseptic solution which has been selected is then to be injected slowly into the bladder, and after having been allowed to remain there half a minute is permitted to run off, and this process is repeated until the fluid returns perfectly clear. During the continuance of this treatment scrupulous care must be taken to prevent the entrance of fresh germs. The catheter which is used should be kept in carbolised oil: the penis should be washed after each act of micturition in a solution of corrosive sublimate (1 in 1,000) or other antiseptic solution, and covered with some antiseptic dressing. Under this treatment the fermentative process will probably be arrested, and the urine will no longer be found to be foul and contain the products of decomposition. In many cases, however, it will be still far from healthy, containing an excess of mucus, and there will still be irritability of the bladder and frequent desire to pass urine. Under these circumstances, the internal administration of buchu, uva ursi, or pareira brava is often followed by the best results; and combined with this, astringent injections, such as those of tannin or acetate of lead, may be used with advantage. The patient's diet must be carefully regulated. All spices and condiments, stimulants, tea and coffee, must be interdicted, and the patient live on the plainest and at the same time most nutritious food that can be selected.

Finally, where all plans of treatment have failed to effect a cure and where the patient is worn out by his sufferings, the surgeon is justified in cutting into the bladder, by a median perineal incision; in order to ensure at any rate temporary rest to the inflamed organ. Sometimes in these cases a cause which was not previously suspected is discovered and removed; and under all circumstances it gives to the organ a period of physiological rest, during which it not unfrequently recovers itself.¹

Vesico-
intestinal
fistula.

This may be the place to mention the occasional (though fortunately rare) occurrence of a fistulous communication between the bladder and some part

¹ I would refer on this head to a paper by Dr. R. F. Weir in the 'New York Med. Record,' June 12, 1880, in which a table is given of 47 cases of cystotomy in the male. In the only operation which I have myself performed the relief was great, and I had an opportunity of ascertaining that it persisted about two years after the operation.

of the intestinal tube. This painful symptom is found usually in cancer, but there are instances (of which I have recorded a very remarkable one¹) in which the formation of the opening seems due to common ulceration of the bowel, or possibly of the bladder, though this latter is, I think, less probable. It occurs usually in the male sex, but sometimes also in the female. The communication is either with the large or small intestine. The appearance and odour of the urine, and probably the pain in the part, first attract the patient's attention, and then the fecal matter can be detected either with the eye or the microscope. As the opening enlarges, and especially when the large bowel is the seat of the fistula, masses of solid feces pass into the bladder, causing obstruction of the urethra, and probably forming the nucleus of a phosphatic stone. In such cases the lumps must be broken up with a lithotrite; and if on careful examination the surgeon is satisfied that the communication is with the sigmoid flexure, the descended colon should be opened. This operation was performed in the case under my care, and with temporary success. The patient was much relieved, and was about to resume his ordinary avocations, when a relapse took place in an even severer form, and he died fourteen months after the operation. The cause of death was found to be the formation of a similar communication with the cæcum, the original opening between the bladder and sigmoid flexure having closed. A most interesting case, under the care of Mr. Hakes of Liverpool, will be found related in the 'Liverpool Medical and Surgical Reports,' vol. iii., and the 'Liverpool and Manchester Reports,' 1875, in which the patient survived five years. After his death the large intestine below the artificial anus was found to be absolutely impervious, and represented only by a fibro-areolar cord.

DISEASES OF THE PROSTATE.

ACUTE inflammation of the prostate is generally a consequence of gonorrhœa, but may be caused also by injuries (one of the most frequent being rough catheterisation), by inflammation of the bladder, by stricture setting up inflammation of the urethra behind the obstruction, by the application of caustic, and by the lodgment of calculus.

Acute inflammation.

The symptoms of acute prostatitis are rigors, feverishness, pain, and irritation in making water, with frequent calls to do so, pain in defæcation, and pain radiating from the loins down the back, thighs, and perinæum. If there is any tendency to piles they will probably show themselves, on examination by the rectum, and this examination is found to be very painful; the prostate is swollen, hard, hot, and very tender; and if a catheter is passed, there is acute tenderness of the prostatic part of the urethra. There will probably be some pus in the urine from inflammation of the prostatic urethra,² even irrespective of abscess, which, however, is very liable to form. This is marked by the continuance of the feverish condition for several days, with rigors, tension, and pulsation in the region of the perinæum and bladder. The difficulty of passing water will also probably increase. Examination with the finger will now prove that the hard prostatic tumour has given place to a soft swelling, in which perhaps the surgeon may detect fluctuation; though, from

Prostatic abscess.

¹ 'Med.-Chir. Trans.' vols. xlix. and l. See also Mr. Pennell's and Mr. Charles Hawkins's cases there referred to.

² Sir A. Clark has called attention to the presence in the urine of hyaline casts formed in the prostatic ducts. He has found these casts in three cases of acute prostatitis. 'Clin. Soc. Trans.' vol. xix. p. 95.

the awkward position in which it lies for palpation, this is not always possible. These abscesses are not, however, always situated inside the capsule of the gland, for very similar symptoms are caused by suppuration around it—peri-prostatic abscess.

The diagnosis of acute prostatitis is not usually difficult if attention is paid to the course of the symptoms, and the disease usually has a favourable issue. It generally subsides of itself on the withdrawal of irritation, or under treatment, or else runs on to abscess, which bursts, with free discharge into the urethra and a sudden relief to the symptoms. But things may not go on so happily. I have seen one striking case in which an abscess, neglected and overlooked, proved fatal. The patient, a young man, was admitted into hospital in a feverish and semi-unconscious condition, and was placed under the care of the physician, as suffering from fever. A gonorrhœal discharge being detected, the surgeon was called in; but he, not suspecting any connection between the gonorrhœa and the fever, made no accurate examination. The patient soon died, and upon post-mortem examination no disease whatever was found except an unusually large prostatic abscess, and the inference was irresistible that if this had been detected and freely opened his life might have been preserved. In other cases the patient recovers from the acute disease, but chronic prostatitis supervenes.

The treatment of acute prostatitis before abscess has formed consists in the very free application of leeches around the anus (or even, if it can be tolerated, inside the bowel), with frequent hip-baths and constant warm fomentations to the perinæum, combined with the moderate use of antimony if the patient is young and strong, and free purging. If retention of urine takes place a catheter must be passed; otherwise it is very undesirable to irritate the parts in any way. But on the first indication of suppuration an incision must be made into the softened part. This is best done from the rectum. It is devoid of danger, and even if the pus is not found the opening will probably relieve the congestion and the pus will very likely make its way soon into the bowel. The opening is best made by putting the patient under an anæsthetic, passing the duckbill speculum into the rectum in the lithotomy position, and fully exposing its anterior wall; though if he is not nervous no anæsthetic is absolutely required. Some abscesses (chiefly, I believe, the peri-prostatic) are not perceptible from the rectum, but fulness and tenderness may be made out by palpation in the perinæum. In these cases a deep exploratory puncture should be made, with the left forefinger in the rectum, and if pus is found the puncture should be extended into a moderately free incision. In most cases no further ill consequences take place; but in exceptional instances the abscess bursts into the urethra also, and a recto-urethral fistula follows, the consequences of which are most distressing, and its cure very difficult. The treatment would be the same as in the cases where a similar accident follows after lithotomy; but I must allow that in the few cases of that complication which I have treated, and seen under the treatment of others, the result has been disappointing. I must refer the reader to the section on Lithotomy.

The acute disease may leave the prostate hardened, somewhat enlarged and tender, with irritable bladder, frequent desire to pass water, with some pus in the urine, glairy discharge from the urethra, weight and pain in the rectum; some tenderness in defæcation, pain in sexual intercourse, and loss of power in propelling urine. This, like most chronic inflammations, is best treated by continuous counter-irritation. Sir H. Thompson recommends the continuous counter-irritation of the perinæum with nitrate of silver or acetum

lyttæ, and the application to the prostatic portion of the urethra of a solution of nitrate of silver—ten to thirty grains to the ounce¹—and the administration of the bromide and iodide of potassium, with tonics, change of air, and sea-bathing.

But it must be recollected that very similar symptoms may follow on prostatic irritation and discharge, the result of gleet or of syphilis. The subject of prostatic discharges and their treatment is not as yet completely understood. Mr. Lee has lately published some interesting lectures on this topic, to which I would refer the reader.²

Enlargement of the prostate gland is an affection of old age; not that all, or the majority of old people suffer from this affection; but that it only occurs after the middle of life.³ It consists either of a hypertrophy of the prostate itself (Fig. 360), or of a tumour developed in the neighbourhood of the gland, but separated from it by a capsule of fibrous tissue (Fig. 359), or of a combination of the two. The enlargement very often affects the whole of

Enlarged prostate.

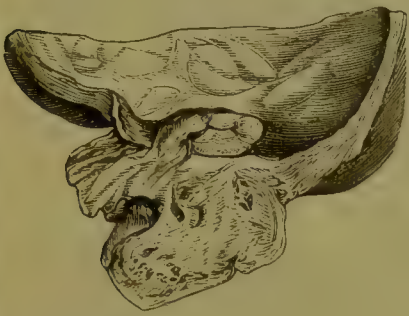


FIG. 359. A section of a prostate gland, in connection with which is a small tumour, separated from the rest of the gland by a definite capsule, and occupying the situation of the 'third lobe.' This tumour consisted of caecal pouches filled with epithelium, and connected together by fine fibroid tissue. There were the usual symptoms of enlarged prostate. The bladder is seen to be much hypertrophied, and at the post-mortem examination was found full of purulent urine. The ureters, pelvis, and infundibula of the kidneys were dilated, and the kidneys themselves contained numerous small abscesses.—From the Museum of St. George's Hospital, Ser. xii. No. 112.

the gland, sometimes only one side; sometimes it consists chiefly of an abnormal development of the central portion—the uvula vesicæ, or third lobe, as it is called. The separate tumours consist of tissue bearing great resemblance to that of the prostate itself, but not perfectly developed, just as in the adenoid tumours which have a similar relation to the female breast. Sometimes, as in Fig. 362, the enlarged prostate is also ulcerated on its surface, and often in old age, either with or without such ulceration, the veins around the prostate gland (prostatic plexus) become engorged and bleed into the bladder. I have seen the urine almost black with blood for many days together from this cause. Hæmorrhage from the prostate is easily known by the absence of stone, by the absence of all previous history and symptoms of cystitis, by the suddenness

Prostatic hæmorrhage.

and copiousness of the bleeding (reminding one in this respect of epistaxis), and by the enlargement of the organ. It rarely requires any treatment. If it does, washing out the bladder with acidulated lotions, and the administration of internal styptics, as acetate of lead or gallic acid, would be indicated.

The first effect produced by enlarged prostate is a certain degree of difficulty and straining in making water, which is most perceptible at the end of the evacuation. This is succeeded, if treatment be neglected, by chronic cystitis. For in all obstructions to the flow of urine, a certain amount being constantly left in the bladder, the walls of the bladder are continually

Symptoms of enlarged prostate.

¹ A catheter-syringe is manufactured with a piston in the stem and an eye at the side. This is filled like an ordinary syringe, the distance to which the piston is withdrawn only permitting it to take up a small quantity of the solution. Then, when it has arrived at the desired spot (which is easily known by the patient's sensations), the piston is slowly depressed while the eye is made to rotate round the circumference of the urethra.

² 'Lectures on Syphilis,' &c. 1875. Lect. ix.

³ The researches of Sir H. Thompson ('Syst. of Surg.' 3rd ed. vol. iii. p. 198) and of Dr. Messer render it probable that enlargement appreciable on dissection exists in about one-third, and enlargement causing symptoms in about one-tenth, of males over sixty.

irritated; the urine, as previously explained, becomes turbid and alkaline; the bladder is never fairly emptied, and some of the residue of the urine must always be left, by which the irritation is kept up and propagated.¹ Then, if the obstruction continues unrelieved, all the usual sequelæ may ensue: dilatation of the urinary passages, leading to uræmia; or inflammation of the ureters and kidneys, leading to pyelitis; and in either case speedy death.

Diagnosis.

The diagnosis is generally very easy. The patient first believes himself to have stricture, and of course he may have both. But a case of uncomplicated enlargement of the prostate is very easily distinguished from one of stricture. The patient's age and the absence of previous history of stricture makes the diagnosis of enlarged prostate most probable, and this is easily confirmed by examination from the rectum, when the enlarged prostate will be found as a hard tumour pressing down into the bowel; or by passing an instrument after the patient has made water, when it will be found that there is no obstacle till the point of the catheter passes under the pubes, when by depressing the handle between the patient's thighs the catheter can usually be easily made to ride over it, and all the more so if a full-sized instrument be used; this is, of course, the direct reverse of what is found in stricture. When the bladder is reached it will probably be found that the patient has not entirely emptied it.

Treatment.

Unless it has been long neglected there is not usually much difficulty in dealing with prostatic enlargement. A soft catheter should be passed daily with all possible gentleness; if there is much muco-pus in the urine the bladder should be washed out; if the enlargement of the gland is considerable, as indicated by the large amount of residual urine in the bladder after the patient has emptied it of as much as he can, the catheter should be passed more frequently, two or three times a day, or even whenever the patient wishes to make water. When the water has become very foul the free injection and washing out of the bladder should not be neglected. The catheter should not be tied in unless there is unusual trouble in passing it. This treatment is palliative only, but I am under the impression that it does tend to prevent the further growth of the disease, which seems to be quickened by irritation. And it certainly saves the patient's life by obviating the various complications which otherwise ensue. Recently attempts have been made to remove portions of enlarged prostate by a supra-pubic cystotomy; and in cases where there is a somewhat pedunculated enlargement of the middle lobe, such as sometimes occurs, and which acts as a sort of valve obstructing the passage of urine, no doubt this operation is followed by beneficial results. Unfortunately, however, we are not in a position at present to say, without cutting into the bladder, which are the cases suitable for operation. In a case in which Mr. Holmes performed this operation in St. George's Hospital, the enlarged portion of prostate was removed with the greatest ease by the supra-pubic incision, and the section of the prostate was attended with remarkably little hæmorrhage.

Retention of urine in enlarged prostate.

Retention of urine often comes on so suddenly and disappears so completely in enlarged prostate, as to prove that it is caused by some sudden spasm, or enlargement from hyperæmia of the gland. The cause is usually sexual intercourse, a debauch, exposure to cold, or urinary inflammation, the result of stricture or instrumentation. There is not usually any difficulty in passing an instrument and relieving the retention in a case of this kind,

¹ Surgical writers sometimes use language which conveys to students the idea that the same urine is constantly retained in the bladder. This, of course, can hardly be intended, but the bladder is excited to inflammation by its never being evacuated.

and then rest in bed, with demulcents and opiates, soon restores the patient to his former condition. In other cases the retention is so nearly constant as to show that it depends mainly on the size of the enlargement, and in such cases the retention if unrelieved soon passes into incontinence. Patients in this condition often believe that no instrumental treatment is required, since they are always passing water; but of course no surgeon would fall into such a mistake. It may sometimes be useful to a patient who suffers from frequent attacks of retention depending on prostatic enlargement to know that he can

probably relieve himself to some extent by placing himself on his hands and knees; though this should never encourage him to neglect the instrumental treatment which his case now urgently requires.

There are some cases (by no means as many as has been taught) in which the passage of an ordinary full-sized catheter is difficult. Sometimes this depends on lateral enlargement, which may be detected by exploration per rectum and an appropriate direction given to the instrument. At other times it depends on the urethra being really lengthened and pushed up into a somewhat vertical direction by the tumour. When this is the case a 'prostatic catheter' must be passed, in order to reach the bladder.

The
prostatic
catheter.

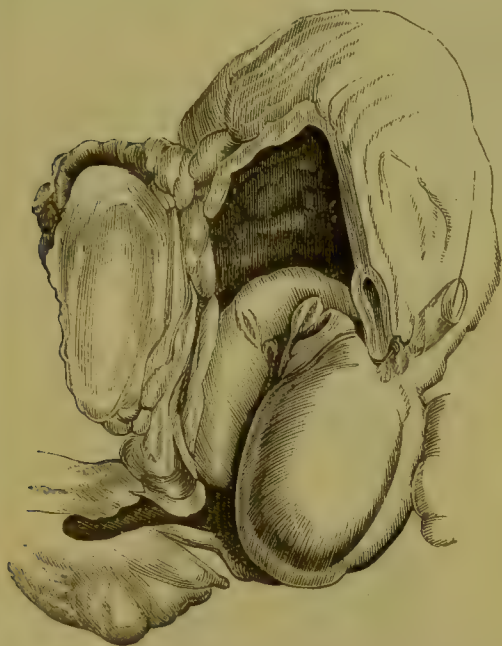


FIG. 360. Bladder, symphysis pubis, and enormously enlarged prostate. A portion is removed from the left wall of the bladder, to show the vertical ascent of the urethra as it enters the bladder.—After Sir H. Thompson.

This is longer and has a larger curve than the ordinary instrument. In other cases the French elbow catheter (*cathéter à coude*) will be found the most convenient, and will effect an entrance where others have failed. This instrument is made with its extremity bent at an angle to the stem (Fig. 361), and is especially useful in riding over an enlarged middle lobe. Again, in other cases a flexible india-rubber catheter without a stylet can be passed into the bladder. Finally, Sir B. Brodie used to recommend that an ordinary gum-elastic catheter with



FIG. 361. Elbow catheter (*cathéter à coude*).

a stylet should be passed down to the obstruction, and then that the stylet should be slightly withdrawn, so as to tilt up the point of the catheter and cause it to ride over the obstacle.

These means will succeed in the great majority of cases. But there are some in which no dexterity will succeed in reaching the bladder, either from the extent of enlargement, or from the existence of false passages. In such cases it has been recommended (and the recommendation is endorsed by Sir B. Brodie, Works, ii. 527) to thrust the catheter through the substance of the prostate, as was done in the case from which Fig. 362 was taken. But this proceeding is now, I think, given up—at least I have not of late years heard of its being done. In many such cases, if the irritation be subdued

Forced
catheter-
isation.

by evacuating the distended bladder two or three times with the aspirator, treatment may be successfully resumed. In others a more permanent opening into the bladder must be made. When the enlargement is not too considerable and the bladder can be felt behind the prostate, most surgeons prefer to puncture from the rectum. I cannot say that this appears best to myself, since the puncture will only give temporary relief and the symptoms may recur. It is quite true that the irritation may subside or the false passages may heal, and then the surgeon may succeed again in passing the catheter. But the same advantages also attend what I conceive to be the better plan in these cases, viz. to puncture above the pubes.

Puncture
of the
bladder
above the
pubes.

This is an operation of no difficulty, and, I believe, of little danger, when the bladder is fully distended. A puncture or small incision is made in the middle line immediately above the pubes; and the fat, if there is much, may be broken down with the director or handle of the knife. Then the finger will feel the fluctuating bladder, and a common trochar and cannula, or a curved one if at hand, is passed in, and a piece of gum catheter passed through to steady it and prevent its slipping out. After about a week or ten days, when the track of the wound is consolidated, the instrument may be removed, cleaned, and changed. The advantage of this puncture is that the cannula can be worn permanently, with little or no inconvenience, if it is necessary. A cannula provided with a shield and stopcock is adapted, and the patient removes the plug when he wants to relieve his bladder. He is thus spared all the annoyance of instrumentation. The bladder, however, must be kept carefully washed out.

Mr. Reginald Harrison¹ advocates in these cases an operation by which the membranous urethra is opened, the enlarged prostate divided to a sufficient extent to allow of the passage of the index finger into the bladder and the retention of a large drainage tube for some weeks, after which, if the urine begins to pass by the natural passage, the tube may be withdrawn and the opening allowed to heal; and he gives several examples in which all the symptoms have thus been permanently relieved.



G. 362. Great enlargement and ulceration of the prostate gland. Retention of urine having taken place, it was relieved by forcibly thrusting a catheter through the substance of the prostate. A bougie is inserted in the artificial passage. A section has been made through one side of the enlarged prostate to show the extent of the hypertrophy.—From a preparation presented by Sir. B. Brodie to the Museum of St. George's Hospital, Ser. xii. No. 109.

Malignant
disease of
the pros-
tate.

Malignant disease only rarely originates in the prostate gland, though its primary occurrence there is indisputable, and in some cases it remains confined to the organ. It gives rise to acute pain, hæmorrhage, and frequent micturition, in fact to many of the symptoms of stone; and in a well-marked instance which occurred in my own practice, it was not till after repeated examination, and under anæsthesia, that I fully satisfied myself of the absence of stone; but the distress is usually even more acute than in stone, and the

¹ 'Brit. Med. Journ.' Dec. 24, 1881, and April 8, 1882.

wasting and loss of health are striking phenomena. There is more pain, also, in neighbouring parts than is usually felt in stone in the bladder. When the tumour has grown considerably it may be possible to assure oneself of its nature by examination from the rectum; but at first it will simulate the ordinary enlargement of advanced life, and these cases almost always occur after middle age.¹

Malignant disease of the prostate includes sarcoma, which is much the more common, and scirrhus, which sometimes, as in other places, undergoes colloid degeneration. It may spread to the neighbouring organs, or may affect the inguinal glands, or fragments of it may be found in the water—in any of which cases the diagnosis will be clear enough. Nothing can be done except to palliate the patient's sufferings as best may be.

Tubercle is found in the prostate in cases where the whole urinary tract is affected, and cysts of the prostate are spoken of, but only as cavities formed by prostatic calculi, which will be described later on. Hydatids have been found lodged in the neighbourhood of the gland, and have produced retention of urine by pressing on the bladder; but the condition hardly allows of diagnosis before operation. The indication will be to open the bladder in the most accessible situation on failing to pass the catheter. Then the nature of the case will probably be recognised, when the hydatids must be freely evacuated by incision, and all remains of them frequently washed out.

Other
affections
of the
prostate

DISEASES OF THE URETHRA.

THERE are cases of congenital obliteration of the urethra, and in a case recently reported by Mr. Foster of Darlington² the malformation was discovered during the first few hours of life, and was successfully treated by boring through the occluding material, which involved nearly the whole length of the urethra, with a curved stylet, along the tract of which a catheter was passed. At the end of a week or ten days the case was complete, and remained so.

Malforma-
tions.

But the malformations about which the surgeon is usually consulted are hypo- and epi-spadias. The former is, in its minor degrees, a very common malformation, and one of no consequence whatever. The urethra opens on the lower surface of the penis at some distance beyond the natural position of the meatus. When, as is most usual, this opening is only a little behind the glands the patient can pass water naturally, and in sexual intercourse the semen will be lodged fairly within the vagina, so that there is no motive for surgical interference. The prepuce also is in these cases usually somewhat misshaped, forming merely a large flap on the dorsal surface of the glans, which falls into the skin of the penis on either side, but does not form a complete circle. Hypospadias, however, in its higher grades is a very serious infirmity. The urethra opens at the root of the penis, the urine runs down over the thighs, so that the patient is obliged to make water sitting, and the semen would be discharged externally if the patient were capable of sexual intercourse; but this is seldom the case, for the penis is bound down to the scrotum by a firm band, which becomes very perceptible in erection, and the organ curves downwards, somewhat as in chordee. This band is probably the remnant of the undeveloped corpus spongiosum.

Hypospa-
dias and
epispadias.

¹ Sir H. Thompson says that it has also been noted in early childhood, but that no cases are on record between the ages of eight and forty-one.

² 'Brit. Med. Journ.' Jan. 3, 1885.

Elaborate attempts have been made to remedy this deformity by plastic operations, and with some success. Three several indications have to be fulfilled: (1) to liberate the penis, so that it may assume its natural direction when erect; (2) to form a new urethra, so that the urine and semen may find a channel to the glans; and (3) to close the original opening. The penis is accordingly dissected free of the scrotum, and raised up to the abdomen. The neighbouring skin is transplanted from the penis and scrotum in two layers laid on each other by their bleeding surfaces, and with the cutaneous surface of the inner flap turned towards the penis to form the new urethra, and after these flaps have adhered and are healed, the fistulous orifice is refreshed and united to the new urethra, a catheter being kept in the bladder. The attempt is worth making in healthy boys or young men; and in one case, in a boy of thirteen, I succeeded in forming a complete urethra, which extended from the corona glandis to the original opening of the urethra in the scrotum.¹ I recently heard of this patient as being the father of two children. In two other cases under my care the operation was so far successful that the patients, previously unable to effect an entrance, were rendered capable of sexual intercourse; but the fistulous orifice remained, the patients declining further operative measures. I once tried the operation in early childhood, but should not feel disposed to repeat it at that age. A very guarded opinion must be given as to the possibility of an infant afflicted with this malformation ever being able to beget children.

The opposite malformation—epispadias—in which the urethra opens on the dorsal aspect of the penis, is very much rarer, and is generally accompanied with great general malformation of the rest of the external genitals. In its extreme degree it constitutes the extroversion of the bladder before spoken of. Attempts have been made here also to put the parts in a more natural condition by plastic operations. In fact, the operation which I performed for extroversion of the bladder was adapted from one which had been practised in epispadias. But it is very doubtful whether any good can be done in such cases.

Stricture
of the
urethra.

Stricture of the urethra is a disease which is very frequent in every rank of life, but of which the worst and most complicated examples are found amongst the poor, who do not understand the gravity of a complaint which is so insidious at first, and who very often have not the time or the means required for its successful treatment. I mention this, inasmuch as, like hernia and many other surgical affections, stricture would not, generally speaking, prove formidable, certainly would very seldom lead to death, if it were made the subject of early and intelligent treatment.

Causes of
stricture.

The cause of stricture is in general either a low inflammation of the sub-mucous tissue of the urethra, or cicatrisation, the result of an injury. A very common cause of stricture seems to be the persistence of a neglected gonorrhœal discharge, and some surgeons believe (and certainly with much probability) that ulceration of the urethra in gonorrhœa, such as is known to occur sometimes, may often prove the starting-point of cicatrisation, and so of stricture. However, speaking generally, it is impossible to prove anything of the kind; the urethra at the seat of stricture displays more or less of induration and thickening beneath its mucous surface, causing contraction of its canal, but no such definite band as we should expect to be the result of the cicatrisation of an ulcer. And though there can be no question that

¹ 'Lancet,' vol. ii. 1879, p. 727.

gonorrhœa is a frequent cause of stricture, yet in many cases of stricture it is impossible to trace any connection with gonorrhœa, or indeed any cause whatever.

Another cause of stricture may be syphilis. Fig. 364 is taken from a case in which the healing of a syphilitic sore led to stricture at the meatus, and I have introduced it also to show how great destruction is sometimes allowed to take place from a disease in itself very readily curable. The simplest means

would, no doubt, have sufficed at first to cure this stricture, which was, nevertheless, permitted to lead, through years of agony, to the patient's death.

The most formidable kind of stricture is that which follows traumatic rupture of the wall of the urethra after a fall or blow. This kind of stricture is generally in the part which passes below the arch of the pubes; although occasionally, from blows or wounds, it may occur elsewhere. The resulting cicatrix is usually very dense, hard, and contractile, so that even after complete dilatation it will recur again and again. It constantly leads to fistula in perinæo, and occasions death or serious complications in spite of the most judicious treatment.

The most common seat of stricture is said by Sir B. Brodie to be the membranous por-

Seat of stricture.



FIG. 363. Stricture of the urethra about three inches from the meatus urinarius, formed by a bridle which is seen crossing the canal. A bristle is passed in above and below this bridle; the dilatation of the canal behind the stricture will be noticed.—From a preparation presented by Sir. B. Brodie to the Museum of St. George's Hospital, Ser. xii. No. 49.



FIG. 364. Stricture at the orifice of the urethra, producing dilatation of the whole urethra, and extensive ulceration, with abscesses in the tissues of the penis, communicating with the ulcerated urethra. There were also several perinæal abscesses. The bladder was enormously hypertrophied, and the kidneys were much absorbed. The urine was of course alkaline, and loaded with mucus and pus. The patient died soon after his admission into the hospital. The stricture of the meatus is believed to have been caused by a syphilitic sore contracted two and a half years previously.—St. George's Hospital Museum, Ser. xii. No. 60.

tion of the urethra. The researches of Sir H. Thompson have, however, proved that in the majority of the specimens contained in museums the constriction is rather in the bulbous than in the membranous part; but it would be hardly possible to detect the difference during life. Any anterior part of the canal may be the seat of stricture, those at the meatus (Fig. 364) being generally the result of accidental circumstances. Fig. 363 shows a stricture in the spongy portion of the urethra, and when this is the case it is very common to find another farther back. Stricture, again, is said to be

met with at the prostatic portion or neck of the bladder, but its existence is denied by the best authors. Sir H. Thompson has never met with a case. Strictures are occasionally multiple. John Hunter speaks of having met with a case in which there were six, but it is rare to find more than two or three.

Forms of
stricture.

The anatomical forms of stricture are various. Fig. 363 shows an example of what is sometimes called the 'bridle-stricture,' in which the obstacle is caused by a bridle or band stretched across the canal, which may with great probability be referred to past ulceration, as may also be those (of which, however, no example has fallen under my own notice) in which a lunated fold occupies a part of the circumference of the urethra, such as is often seen in the rectum after the healing of an ulcer. More commonly the obstruction is a mere narrowing of the canal at the part affected, as if by a diaphragm placed in it, the 'annular' stricture (Fig. 365). When this diaphragm extends for some distance under the mucous membrane on either side of the point of greatest obstruction, it is called the 'indurated annular stricture,' and when a considerable part of the canal is constricted it is denominated a 'tortuous' or a 'cartilaginous' stricture.

The practical importance of these distinctions is not very great, except in regard to the obstacles which may be experienced in the forcible dilatation of the stricture. But it must be allowed that so much is stricture (meaning thereby real organic material obstruction) complicated by spasmodic action of the muscles around the urethra, and of the muscular fibres which form part of it, that it is often very difficult to determine during life how far the obstruction occupies the walls of the tube, so that a stricture which during life had been supposed to extend over a long distance has been found after death to have been, mechanically speaking, insignificant.

Symptoms
of stricture
and its
sequelæ.

The symptoms of stricture are at first simply mechanical difficulty in making water, and consequent prolongation of the length of time required to satisfy the calls of nature, with (as the disease advances) some straining, leading very likely to involuntary discharge of some of the contents of the bowel, and prolapsus. The patient often finds that after he thinks he has finished making water, more or less dribbles out; this has collected in the urethra behind the stricture, and is gradually forced through it by the action of the walls of that tube. Still, there is no evidence of any alteration in the parts not immediately implicated in the stricture, or any change in the functions: and the disease is, no doubt, easily brought under the control of treatment. But if it is neglected, other graver symptoms supervene, which are partly mechanical and partly vital. The difficulty in micturition may pass into total retention, or retention may come on from time to time after any excitement, and, with or without retention, very grave ulterior consequences may ensue. Any obstruction to the flow of urine will lead, as it would if the urinary tract were a piece of lifeless elastic tubing, to gradual loss of tone and distension of the part behind the obstruction. Thus, in every such obstruction, whether from impacted calculus (Fig. 394), stricture (Fig. 364), enlarged prostate (Fig. 359), tumour of the bladder (Fig. 358), or any other

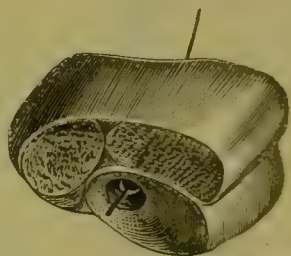


FIG. 365. Stricture of the urethra. About two-thirds of the tube is closed by a diaphragm of no great thickness, in which a small circular hole is seen, with a bristle passed through it.—From a preparation in the Museum of St. George's Hospital, Ser. xii. No. 56A.

cause, the consequences (apart from the results of vital irritability) would be dilatation of the part of the urethra behind the obstruction, of the bladder, of the ureters, and, finally, of the pelvis of the kidneys, leading to absorption of their cortical structure, suspension of the secretion, and death from uræmic poisoning. But this supposes the absence of vital irritability, which is of course never entirely the case. Sometimes even in so muscular an organ as the bladder the effects of pressure overcome those of irritability, and it becomes distended and thinned. Even then, however, its walls are inflamed as well as thinned; but it is much more common in the bladder for the effects of irritation to overcome those of pressure, so that the walls of the bladder are thickened and fasciculated, and its cavity perhaps much diminished, or certainly not increased. In the urethra, on the contrary, which, though muscular, is much less so than the bladder, and which is exposed more directly to the action of pressure, there is almost always dilatation behind the stricture (unless relieved by ulceration behind the obstruction, leading to urinary fistula), which in stricture of the meatus may involve the whole of the urethra (Fig. 364). But along with this there is also inflammation of its walls, leading to ulceration and abscess round the urethra. In the ureters we commonly see only the effects of distension, the signs of inflammation being confined to some vascularity of the mucous membrane not usually perceptible after death. In some cases of obstruction, the kidneys will be found merely distended, with atrophied cortical structure and expanded pelvis. This state of things is not necessarily marked by any prominent symptoms before the fatal coma which precedes death from uræmic poisoning. But far more commonly, even in cases in which there is some amount of distension, the secreting structure of the kidney is also inflamed. The kidney is more vascular than usual, with deposits of yellow lymph and small abscesses scattered through its cortical part, and sometimes (in fewer numbers) in the cones, with thickened and adherent capsule, with distended tubes forming defined white lines in the cones, passing from the apex to the base of the pyramid, with distended and inflamed pelvis containing an offensive mixture of urine and pus, and with phosphatic deposits on the lining membrane. This condition of 'pyelo-nephritis' is sometimes termed 'surgical kidney,' and is set up in the following way. In consequence of the hypertrophied condition of the bladder, it offers a resistance to the accumulation of urine in it, and a retention of the secretion in the ureter and pelvis of the kidney which results in their dilatation, and predisposes them to inflammatory changes. If now an acute cystitis is set up, as it very frequently is, by the introduction of some ferment into the retained urine, and resulting putrefaction, we have the septic inflammation spreading upwards through the ureter to the dilated pelvis, calices, and uriniferous tubes, already predisposed to inflammatory changes. In proof of this it may be stated that micrococci, similar to those found in putrid urine, and to which the putrefaction of the urine is believed to be due, are to be found in large numbers distending the uriniferous tubes. The disease may be caused by anything which produces ammoniacal decomposition of the urine; but surgical causes, stricture especially, and also enlargement of the prostate, as causing obstruction, and stone in the bladder, with the operations undertaken for its relief, as causing obstruction and irritation, are the most common. Retention of urine is a potent auxiliary in producing this renal affection, though it is not a necessary condition.

Effects of
obstruction
on the
kidneys.
So-called
'surgical
kidney.'

The symptoms are not very marked, and are, as Dr. Dickinson says,

general rather than local; 'they point to contaminated blood rather than to disturbance of glandular function.' These symptoms are, pain in the loins sometimes, shivering almost always, febrile symptoms always, with rapid prostration, brown and dry tongue, sometimes frequent vomiting, hiccough, diarrhoea, profuse sweating, and later on yellow cadaverous complexion, low delirium, increasing unconsciousness, and ultimately complete coma and death. Erysipelas, pulmonary congestion, and sometimes distinct secondary deposits, are occasional complications. The fatal issue of the case usually takes place in about a fortnight after the first onset of these symptoms, but sometimes much earlier, and occasionally with extreme suddenness (as in the well-known case of the late Emperor Louis Napoleon); but the kidney-affection is said by Drs. Dickinson and Wilks not to be always fatal. The treatment can hardly amount to much. If stricture be the cause it may be thought justifiable to divide or rupture it, in order to wash out the bladder freely, and endeavour to correct the state of the urine. The bladder should be washed out with some antiseptic solution. Quinine must be given internally. The patient should be kept warm and covered with blankets in order to promote the action of the skin. A fluid diet, consisting principally of milk, and without stimulants, except in very asthenic cases, should be ordered. Occasionally fomentations to the loins, where there is much tenderness, or counter-irritation where the secretion of urine is very scanty, is of service.

Complica-
tions of
stricture.
Fistula in
perinæo.

Besides these fatal sequelæ of stricture there are various complications which must be noticed.

The most frequent is *fistula in perinæo*, when the mucous surface of the urethra gives way behind the stricture, and allows the urine to make its way towards the surface gradually (the inflammatory condensation of the tissues around preventing extravasation of any large quantity of urine), until it burrows through the skin and the water passes through the unnatural channel sometimes wholly, but more frequently in part, some of it escaping also from the meatus. There are often more than one, and sometimes many such fistulæ, and they open not only in the perinæum, but in the penis, scrotum, buttock, or groin also.

Urinary
abscess.

When the ulceration which leads to the escape of a small quantity of urinous fluid from the urethra does not proceed to the surface, but remains limited by inflammatory exudation (as in the cavities seen in Fig. 364), a small, hard, exquisitely painful swelling results, which is generally situated in the perinæum, and hence called 'abscess in perinæo'; but as it may be (as in the figure) in the penis, or even in the groin, the more general name, 'urinary abscess,' now in common use, is better.

Extravasa-
tion of
urine.

Or, again, instead of merely giving way by a comparatively slow limited process of ulceration, the urethra may yield suddenly and entirely to the pressure,¹ when the urine is poured violently out into the tissue of the perinæum, scrotum, penis, &c. This is called *extravasation of urine*. If the stricture be in the spongy body (as in Fig. 363), the urine may be effused only into the penis, the perinæum being unaffected; but this is rare. Generally speaking, the stricture is at or about the bulb of the urethra, and the urine is effused between the triangular ligament (Camper's ligament or the superficial layer of the deep perinæal fascia) behind, and the deep layer of superficial fascia in front. As the latter membrane is attached on either side to the rami of the ischium and pubes, the effused fluid cannot pass on to the inner side

¹ This is often accompanied by a feeling of sudden relief to the painful sensation of straining under which the patient has been suffering, and a deceptive lull occurs.

of the thighs. The attachment of the same membrane to the deep fascia around the lower border of the transversus perinæi muscle prevents the urine from passing backwards to the anus and buttock. But there is no obstacle to its passing forwards to the scrotum, penis, and abdomen, and this is, accordingly, the path it takes. As the putrid urine comes into contact with the cellular tissue it sets up acute phlegmonous inflammation, rapidly running on to gangrene, with its usual concomitant of low typhoid surgical fever. At or just below Poupart's ligament, the superficial fascia of the abdomen adheres to the deep fascia; i.e. there is no subcutaneous cellular tissue, or very little, and there the inflammation ceases at least for a time. Ultimately, it is said, the adhesions which connect the deep and superficial fascia may be stretched and the inflammation creep down the thigh; but this must be very rare, as the patient usually dies if the inflammation does not stop before this takes place.

Finally, a still more terrible catastrophe may occur—the rupture of the bladder, followed by extravasation of urine, probably into the peritoneal cavity, which is necessarily fatal; or into the pelvic cellular tissue, which in all probability will be so. This is a very rare effect of stricture, but undoubted examples of it are recorded.¹ It need not, however, be taken into account in the prognosis or treatment of a case, being altogether exceptional.

Rupture
of the
bladder.

Although many of the above-described symptoms are vital, the origin and source of the disease is purely mechanical, and so must its treatment be at first. As a general rule, if an instrument can once be introduced through the stricture or strictures into the bladder, the case becomes at once amenable to treatment. Nor is there any difficulty in doing this in an uncomplicated case of recent spontaneous stricture. But in old neglected cases and in the worst forms of traumatic stricture it is exceedingly difficult, and in some cases impossible. To these cases the term 'impassable stricture' is applied.

Treatment
of stricture.

In endeavouring to pass an instrument for the first time in any case of stricture its features should first be carefully studied. We should in the first place endeavour to exclude the idea of mere spasm, or what is called spasmodic stricture (p. 807), or of mere prostatic enlargement (p. 781), and satisfy ourselves that the case is one really of organic stricture. A reference to the above pages will indicate the diagnostic symptoms. The urine should be examined (if the patient can pass any) to show the state of the bladder; and the condition of that organ as to distension should be carefully ascertained. When the bladder is considerably distended it rises up from the pelvis into the abdomen, forming a definite rounded tumour, perfectly dull to percussion, and sometimes rather sensitive to pressure, which may reach up as far as the umbilicus, and which can be felt in the rectum (unless the prostate is very much enlarged), and fluctuation can be communicated to the finger in the rectum by tapping on the abdominal tumour. When, on the contrary, the abdominal muscles are merely rigid from spasm (a condition not unfrequently mistaken for distension of the bladder), all these symptoms are absent except the sensation of resistance above the pubes. There is no definite rounded tumour, no dulness on percussion, no projection in the rectum, and, of course, no fluctuation there.

Examina-
tion of
distended
bladder.

Besides the above points, it is desirable (if the patient is a person whose answers can be trusted) to know what has been about the usual size of the stream latterly and what it is now, since, if there is a great difference within

¹ One case is recorded (Harrison, 'Disorders of the Urinary Organs,' p. 32), in which the bladder seems to have been ruptured in retention from spasm.

a very short time it may fairly be conjectured that a good deal of the dysuria depends on spasm. It is also important to ascertain what, if any, attempts have been made already to pass an instrument, and whether they have been accompanied by much pain and bleeding, in which case the existence of a false passage may be suspected if the instrument failed to draw off the water.

Catheter-
isation.

When the surgeon has reason to diagnose the existence of organic or permanent stricture, an instrument should be passed at the earliest convenient moment. This need not necessarily be immediately after the case is seen, for if there is no retention of urine, an interval of rest in bed, with a warm bath every night, and abstinence from any cause of excitement, may form a good preparative, and facilitate the introduction of the catheter or bougie.

Surgeons vary as to the kind of instrument which they habitually employ at the commencement of a case of stricture. Some prefer the common metal catheter, others the gum catheter with or without stylet, others a probe-pointed or simple or flexible bougie, others a solid metal bougie. The matter is more one of individual preference and of habit than of rule, and is hardly fit for discussion in an elementary work.¹ But whatever instrument is used, dexterity in its management and the utmost gentleness in its introduction are essential both to the comfort of the patient and to the success of the treatment. Dexterity can only be acquired by practice, and therefore it is of the utmost importance for students to embrace every opportunity of practising the passing of catheters on the dead subject, and on those who require the passage of a catheter without any obstruction, before undertaking the treatment of a really difficult case. In the natural condition of things there are only two material obstacles to the introduction of an instrument, viz. hitching the point in one of the lacunæ of the urethra, and pressing it against the triangular ligament as the point dips under the pubes. The former hitch occurs at any part of the spongy portion, very commonly near the meatus. Both can easily be overcome by withdrawing the instrument a little and allowing it to find its own way without the use of any force. In dexterous hands a solid instrument, or even a metal catheter, appears rather to drop into the bladder by its own weight than to be pushed into it; and this dexterity is very well acquired by practising on the dead subject until the art of passing the catheter easily with one hand is perfectly familiar. Though the difficulty from spasm and pain does not exist in the dead subject, yet the laxity of the tissues causes a difficulty of its own, and if a man can pass instruments with perfect ease on the dead, he has gained a most important advantage for commencing his practice on the living.

Besides these merely mechanical obstacles, however, there is the difficulty resulting, particularly in nervous persons, from real or apprehended pain, throwing the muscles around the membranous part of the urethra into spasmodic action. This sometimes produces contraction of other parts of the canal; but as a rule the spasmodic resistance is not met with till the point of the catheter passes under the pubes. If the instrument be gently held (rather than pressed) against the contracted part of the tube the spasm will probably

¹ At the risk of being considered old-fashioned, I will say that I believe the common metal catheters, if only they be used with proper gentleness and dexterity, superior for general utility to any other form of instrument, and next to them the common gum catheters; that I see little use in conical bougies (except in rare cases), and still less in probe-pointed instruments, bougies à boule, &c. But all this is mere matter of habit and opinion, and to a certain extent of fashion.

soon relax and the instrument jump into the bladder. In difficult cases, whether of stricture or enlarged prostate, much assistance will be obtained from passing the left forefinger into the rectum to ascertain the position of the point of the catheter and to guide it. Catheters are passed either in the erect or recumbent position. This depends in a great measure on the circumstances of the case and the habitual practice of the surgeon. Some surgeons prefer to pass instruments with the patient standing against the wall, perfectly erect, with his feet resting against the wall, and the surgeon seated in front of him, but if the patient is nervous or unaccustomed to instruments he may easily faint, and the surgeon must be prepared for that event. Probably the better position is to lay the patient flat on his back, with the pelvis raised by a hard pillow placed under the buttocks. The surgeon should stand on the left side of the patient and pass the instrument with the right hand; whilst the left one is free to pull the penis forwards and thus put the mucous membrane on the stretch, or, if necessary, to introduce the forefinger into the rectum in order to guide the instrument onwards into the bladder. The catheter, if a metal one especially, should be well warmed and lubricated with some carbolised oil.¹

In introducing it, it is passed gently and steadily down the urethra, with the point against the upper surface of the canal, which is more fixed than the lower, until it reaches the situation of the triangular ligament. The handle of the instrument is then raised from the body of the patient and the point carried under the pubes into the bladder by depressing the hand which grasps the catheter between the patient's thighs.

The passage of a catheter, especially for the first time, is occasionally attended with troublesome, and sometimes even serious, consequences. Amongst these are urethral fever, hæmorrhage and inflammation of the urethra and bladder and testicle.

Accidents
attending
catheter-
ism.

A feverish condition is not very uncommon after catheterisation and other operations on the urinary passages. It usually occurs after unsuccessful or rough catheterisation, and in persons with disease of the bladder or kidneys; but it may occur after the easy passage of the instrument, and in healthy persons. In some cases its constant recurrence offers a great obstacle to successful treatment. It usually commences with a severe rigor, in which the temperature will rise as much as seven degrees; and this commonly occurs within a few hours of the passage of the catheter, but it may come on more insidiously and run a more chronic course. As prophylactic measures, great gentleness, the administration of an anæsthetic, equable warmth, care in diet, and a full dose of quinine and opium before the use of the instrument are to be recommended. The fever itself is best treated, I think, with aconite or with quinine, combined with alcoholic or diffusible stimulants and fomentations to the perinæum. There is no doubt that the fever sometimes proves fatal, even in the absence of recognisable disease of the kidney or bladder; but usually in fatal cases there is either renal degeneration or pyæmia from absorption of putrefying material by the urethra. Sir Andrew Clark² says that occasionally in perfectly healthy men or those with no discernible evidence of disease, the commencement of the habitual use of the catheter is followed by fever of the remittent type, which is neither distinctly uræmic nor distinctly pyæmic, but which may terminate in death, and that for the fatal issue in such cases no adequate

Urethral
fever.

¹ 'Land's oil' is generally used. It consists of olive oil 15 parts, castor oil 4 parts, and carbolic acid 1 part. To this 5 per cent. of cocaine may be advantageously added.

² 'Lancet,' Dec. 22, 1883, p. 1077.

structural explanation can be found. Mr. Henry Morris¹ argues that it is to the state of the kidneys prior to surgical treatment and not to the state of the bladder after the commencement of catheterism that we ought to look for an explanation of this form of fever.

Hæmorrhage.

Bleeding may follow the introduction of a catheter, either when the stricture is congestive or from the formation of a false passage. When after experiencing some resistance the instrument, being pressed forwards, makes a sudden jump and remains fixed, while the patient complains of pain and loses some blood, the surgeon may conclude that a 'false passage' has been formed. No further attempt to pass an instrument should be made for a few days under these circumstances. It is rare for any formidable symptoms to ensue; for the false passage being valvular towards the bladder, the urine does not find its way into it and there is seldom any serious bleeding. Occasionally in congestive stricture the hæmorrhage after catheterisation is rather profuse, but can generally be checked by the application of cold. Finally, hæmorrhage may occur from the kidney as a result of the passage of a catheter. It would appear that any irritation of the deeper portion of the urethra or bladder may cause, from reflex action, congestion and hyperæmia of the kidney. This may be followed, if the kidney is sound, by the passage of a small quantity of blood in the urine for some days; but if the kidney is diseased more serious results may be set up; interstitial nephritis may follow or suppression of urine may ensue.

The introduction of a catheter, especially if any force has been employed or too large an instrument has been used, is occasionally followed by urethritis, prostatitis, or cystitis, and not unfrequently inflammation of the epididymis, from an extension of the inflammatory process down the ejaculatory ducts, and vasa deferentia results. This condition will be considered in the sequel.

My own practice in commencing the treatment of a case of stricture is first to use a very small gum catheter without a stylet. If this passes easily I take a larger size, until the measure of the stricture is taken. If it passes, but with much difficulty, it is best, if circumstances permit, to tie it in for a couple of days or so. If this is tolerated, the case will be found much more tractable.

Gradual and rapid dilatation of stricture.

The two most common plans of treatment are by gradual and by rapid dilatation. In the former, after an instrument has been passed once or twice on successive or alternate days, the next larger size is taken, and so on until in a few weeks the stricture is dilated so as to admit a catheter the natural size of the tube. This size of course varies in different persons. In practice the No. 10 of our ordinary English scale may be taken as an average.² The patient is then taught to pass a similar catheter for himself, and the surgeon gives him such directions as to the frequency of passing it as he thinks fit, once or twice a week, according to the apparent tendency of the stricture to contract, and he is to be told that although after a few years it may no

¹ 'Lancet,' Dec. 22, 1883, p. 1080.

² The normal calibre of the male urethra is generally believed to be represented by a tube about one inch in circumference. Dr. Fessenden N. Otis of New York believes that this is too low. He says that he has met with two cases in which calculi measuring $1\frac{1}{2}$ in. in their largest and $1\frac{1}{8}$ to $1\frac{1}{4}$ in. in their smallest circumference passed without any incision, and that he has measured urethrae even larger than this. He also figures an instrument for measuring the size of the urethra behind the meatus.—'Lancet,' July 11, 1874. But in practice the patient may be well satisfied when even No 8 can be easily introduced. Some surgeons, however, teach that dilatation ought in all cases to be carried as far as No. 12.

longer be necessary to do this so often, yet that it is dangerous to neglect the occasional passage of an instrument in order to ascertain whether there is any tendency to renewed contraction, on the first suspicion of which he should immediately consult a surgeon.¹

The other method, by rapid dilatation, is one which has been long a favourite plan of treating stricture at St. George's Hospital, and which Mr. Savory has recently strongly recommended from his experience at St. Bartholomew's.² It is a very convenient and very rapid method of treating cases in which confinement to bed is not objected to ; and is therefore peculiarly appropriate to hospital practice. As much progress may often be made in the dilatation of a stricture in ten days by this method as would have been obtained in a month by that of gradual dilatation. I cannot better describe the plan than in Mr. Savory's words :—

Rapid
dilatation
of stricture.

'After an instrument has been introduced and secured the patient should, of course, lie quiet—in the great majority of cases he will rest most comfortably on his back. It is well to move it slightly and very gently in the urethra from time to time. This gives the surgeon additional assurance that all is right, and tells him at once the degree of progress that has been made by the loosening of the stricture. The instrument may be either withdrawn at the end of twenty-four hours, and one a size larger introduced, or it may be left for two or three days, when it may be replaced by a much larger one. As a rule I change the first instrument, if it be a small one (No. 1, 2, or 3), at the end of twenty-four or forty-eight hours, when I can usually pass No. 4 or 5, leaving that in for two or three days, when No. 7, 8, or 9 can be easily substituted. As to change of instrument, I am chiefly guided by the size of the catheter and the amount of suffering experienced by the patient. A large instrument may be retained longer than a small one, and the withdrawal of the original instrument and the substitution of another often gives relief when the patient is restless. Of course, patients vary much in their ability to bear a catheter in the urethra. To some it seems to give little or no trouble ; they make no complaint, feed and sleep well, and, in short, give no signs of disturbance of any kind ; while others complain very loudly, declare their utter inability to bear the instrument any longer, and urgently demand its withdrawal, sometimes withdrawing it themselves. In my experience these latter cases form the exception to the rule, and even in these I think the difficulty may usually be overcome. In the worst cases of stricture, where only the smallest instruments can be passed, the chief difficulty in treatment is overcome if an instrument can be retained for twenty-four or forty-eight hours.

'In my opinion the mode of action of this plan of treatment contrasts favourably with that of any other. The stricture is overcome—the abnormal tissue is removed—by constant pressure. The great influence of pressure in producing absorption is a well-recognised fact. We are familiar not only with many physiological, but also with many pathological illustrations of its potency. And it comes in very happily for the remedy of stricture. When

¹ Much has been said of late by those who advocate the frequent resort to operative interference as to the permanence of the cure after such operation. I can only say that no evidence has up to the present time been adduced (as far as I know) to invalidate the following opinion of an excellent recent author : 'You may exercise pressure upon it (i.e. the deposit which forms the stricture), you may divide it with the knife, or act upon it with caustics, but you cannot entirely remove it, or deprive it of its inherent quality of contraction.' R. Harrison, 'Lectures on Disorders of the Urinary Organs,' p. 29.

² See 'St. Barth.'s Hosp. Reports,' vol. ix.

an instrument is then introduced it is tightly grasped by the contracted portion of the canal, but is loose and free elsewhere, so that pressure is brought to bear at the very spot where it is required, and there only; and in proportion to the amount of good effected is the degree of its action reduced. It acts not by mechanical force, but by a physiological process. Of all methods of treatment this undoes the mischief in the most natural manner; and herein, I submit, is its claim to be considered the best.'

The drawbacks of the plan, besides the confinement which it entails, are that in some patients the retention of the instrument causes pain and inflammation, and that frequently, if after-treatment be neglected, the recontraction is even more rapid than the dilatation has been. But the former danger can easily be guarded against by carefully watching the case, and withdrawing the catheter if it really seems to be setting up mischief, of which the condition of the urine will be even a more trustworthy guide than the complaints of the patient. And the tendency to recontraction after cure can easily be obviated by a somewhat more frequent passage of the catheter than is needed after gradual dilatation.

Method of
tying a
catheter
in the
bladder.

A few directions are needed as to the mode of tying in a catheter. This can be done in various ways. The easiest, though not the most secure, is to tie a tape round the end of the catheter with a clove-hitch, or to pass tapes through the rings made on the ends of catheters which are intended to be retained, and then to secure the ends of the tapes under one or two pieces of strapping rolled circularly round the penis. The insecurity of this plan depends on the loosening of the strapping by the various conditions of erection and flaccidity of the penis.¹ A more secure plan is to pass the tapes which hold the catheter through the substance of a T-bandage, or of a broader piece of tape arranged after the manner of a T-bandage. The tape attached to the catheter ought to be loose enough to allow the instrument a little movement in the bladder, but tight enough not to permit it to slip out. The T-bandage should be as tight as is comfortable to the patient.

Mr. Savory believes that a silver instrument can be as conveniently retained as a gum catheter. My own inclines to the general opinion that a soft catheter is less irritating than a metallic one; but the difference is certainly not very great.

The same instrument should not be left in the bladder too long. I once saw a case in which the prolonged retention of a metal catheter in the bladder caused ulceration of its coats and perforation leading into the peritoneal cavity. This is of course very rare, but it is very common to see a catheter become coated with phosphatic deposits, and this increases the irritation of the bladder.

So much for the treatment of strictures in which the catheter can be passed.

Treatment
of impass-
able stric-
ture.

Should the surgeon be unable to pass any instrument, the treatment of the case will vary according as there is or is not retention. When there is not, the attempt will be put off till another day, the patient being prepared for the renewed attempt as above prescribed (p. 792). But if he is suffering from retention of urine, unless the bladder be distended to an alarming extent, a full dose of laudanum (say 30 or 40 drops) should be given in a little hot water, and he should be put into a hot bath until he begins to feel faint. Then if the retention has been relieved in the bath (which is often

¹ For private patients who have to wear a catheter, a little apparatus is sold to buckle round the penis, with rings to which the catheter is attached.

the case) he should be put to bed and left quiet till another day, otherwise the surgeon should try to introduce the catheter while the patient is still in the bath. If this attempt also fails, careful examination is to be made to ascertain how far the distension of the bladder has gone, and whether there is any sign of fulness or great pain in the perinæum. If not, the same measures may be repeated, and I have seen cases treated with success after numerous repetitions of such attempts ; but they are of course not free from the risk of extravasation of urine occurring unexpectedly, on which account Mr. Cock¹ recommended the puncture of the bladder per rectum in preference to perseverance in the attempt to pass the catheter when a patient and sufficient trial has proved fruitless. At any rate, at some period or other, surgical relief must be given. Three courses are open—to puncture the distended bladder from the rectum or above the pubes, or to force a way into it with the catheter. The latter (‘ forced catheterisation ’) is no longer employed, except possibly by some surgeons in cases of great enlargement of the prostate, under which heading it has been discussed.

Puncture of the bladder from the rectum is a simple operation, and in the cases which I have seen it has proved quite as successful as the condition of the patients permitted. It is to be employed in impassable strictures at such a time as in the judgment of the surgeon is desirable. It must be remembered that, even allowing that ultimately the retention of urine may be relieved, whether instrumentally or otherwise, before extravasation occurs, this argument is not of itself conclusive, in order to show that the operation of puncture is not desirable, since every hour which elapses increases the patient’s sufferings and the inflammation of the urinary organs, while the repose that follows the puncture is of course complete : and after the cannula has been retained some time in the bladder, the stricture, being no longer irritated by constant straining and the contact of putrefying urine, will probably become much more tractable. The matter must be left to the surgeon’s judgment, weighing the circumstances of each case. The fact that no case of stricture had been admitted into St. George’s Hospital which was held to require puncture by the rectum from the time of Sir E. Home down to the year 1852, when Mr. Cock’s paper was read at the Medico-Chirurgical Society, certainly shows that the operation is not often rigidly necessary ; while the fact that it has been very frequently performed there in the comparatively few years which have elapsed since that date proves that Mr. Cock succeeded in showing that in many cases, even if not rigidly necessary, its more early performance is advisable. The operation itself is done thus. The patient is put up in the lithotomy position, and had better be narcotised. The surgeon, being provided with a curved trocar and cannula made for the purpose, examines the bladder with his left forefinger in the rectum in order to define the posterior border of the prostate gland, and to make himself sure that the fluctuation of the urine in the bladder can be felt with that finger when percussion is made on the bladder above the pubes. Having ascertained this beyond doubt, he passes the cannula, without the trocar, up the rectum and fixes it with his left forefinger just behind the prostate, on the place where the fluctuation of the bladder is felt. His assistant holds the shield of the cannula in this exact position while he takes the trocar, passes it through the cannula, and then drives it into the bladder with a decisive plunge, as though he wished to bring it out through the abdominal wall above the pubes. There can be no risk in plunging it in boldly, if the bladder

Puncture
of the
bladder
from the
rectum.

¹ ‘ Med.-Chir. Trans.’ vol. xxxv. p. 153.

is well distended; while if it be more gently introduced it may either not perforate the bladder at all, or to so short a distance as to slip away again readily. It is well to pass a long piece of gum catheter through the cannula in order to fix it more securely in the bladder, and it is to be tied in in much the same way as a catheter (see p. 796). The cannula is not to be stopped, but the urine can be conducted into a vessel below the bed by fixing an india-rubber tube to it; otherwise it must soak into oakum or tow, which is to be frequently changed. After seven to ten days a cautious attempt should be again made to pass the catheter, and if this is successful the cannula is to be withdrawn; otherwise it may be left even for as long as a month. In a case under my own care, however, it became necessary to withdraw it after about three weeks, in consequence of the diarrhoea caused by the dribbling of water into the rectum, although no instrument could be introduced. The patient, however, was relieved of his retention and was satisfied with this relief, and so I lost sight of him.

Puncture of the bladder above the pubes is not usually necessary in cases of stricture unless when they are complicated with extreme enlargement of the prostate gland. Moderate enlargement of the prostate does not preclude the possibility of puncture per rectum, as shown by a preparation in the Museum of St. George's Hospital from a patient of Mr. Tatum, in whom the cannula slipped out accidentally and the puncture was repeated. No difficulty was experienced either time, though there was considerable enlargement of the prostate gland. The operation of puncture above the pubes has been described in speaking of enlarged prostate.

The aspirator for puncture of the bladder.

The aspirator has of late been often used for the relief of stricture, by evacuating the bladder above the pubes. The method is more adapted to retention coming on suddenly from 'congestion' or 'spasm,' in cases of stricture not previously very severe, than in those of formidable organic stricture; but in appropriate cases I have seen much benefit from it. The operation, however, slight as it is, is not devoid of its own special dangers. Mr. Bennett, in a communication to the Medical and Chirurgical Society,¹ relates a case in which extra-peritoneal rupture of a diseased bladder took place as a direct result of its puncture by an aspirator needle. He concludes that 'aspiration of the bladder for relief of retention of urine is a more serious proceeding than is usually supposed, and can only be resorted to with safety in recent and acute cases in which the bladder walls are presumably healthy.' In appropriate cases it relieves the patient from the pain of the retention, and takes off from the stricture the irritation caused by straining, and by the pressure of the urine. A case is recorded² where the aspirator was used fifteen times, with immediate relief each time, and without any injurious after-consequences; but in most cases the stricture becomes pervious after one or two punctures. If it does not, there can be no danger in repeating the puncture frequently, although the chance of relief in this way becomes less and less with each puncture. In those cases, however, where there has been long-standing stricture, with constant difficulty in passing water, and when, therefore, it is probable that the walls of the bladder are much diseased, it is wiser, if the stricture is impassable, to perform perineal section, when at the same time the stricture can, if thought desirable, be divided.

Treatment of impassable stricture where

Such is the treatment of impassable stricture when complicated with retention of urine. There are, however, strictures which the surgeon finds impassable, and yet there is no retention. In such cases much time and patience

¹ 'Med.-Chir. Trans.' vol. lxx. p. 207.

² 'Brit. Med. Journ.' May 23, 1874.

should be employed. Rest in bed, free purgation, and the constant use of the warm bath, will get the organs into a quiet state, and some day the surgeon will almost certainly succeed in reaching the bladder—an attempt which is greatly facilitated by anæsthesia. But if he does not, what must be done? there is no retention.

The patient is, perhaps, free from retention while quiet, but is liable to it at any time after exercise, exposure to weather, drinking, or sexual intercourse, and his life is made a torment to him by constant ineffectual instrumentation. For such cases the most radical cure is the old operation for stricture called 'la boutonnière,' or perinæal section, which must be carefully distinguished from Syme's operation, or external urethrotomy on a grooved staff—an operation which can only be performed when the stricture is *not* impassable.¹

The operation of perinæal section is thus performed. The patient is to be secured in the lithotomy position, the perinæum having been shaved. A large grooved staff is to be passed down to the anterior face of the stricture and carefully maintained in position by an assistant. If a false passage is known or suspected to exist, the surgeon must take the greatest care to ascertain that the staff has not passed down it, but is in the middle line, i.e. in the urethra. If there is a fistula in perinæo through which a director or female catheter can be passed into the bladder, as is often the case, it facilitates the operation very materially. Perinæal section.

An incision should now be made in the raphé of the perinæum in nearly its whole extent. As the incision must deepen at its lower part, it saves time and lessens the risk of losing the middle line to make this incision boldly by placing the left forefinger in the rectum as a guide, then plunging the knife with its edge upwards deep into the perinæum above the finger so as just to avoid the rectum, and cutting out to the skin. The staff is then to be exposed by reversing the knife and dissecting carefully until its point is reached. Now commences the difficult part of the operation—the attempt to find the posterior part of the urethra by a dissection conducted along the course of the canal. If there is an instrument passed through a fistulous passage into the bladder, the posterior part of the urethra cannot of course be missed; but it does not follow that the dissection will be conducted along the urethra—still less when there is no such guide. Indeed, I have seen, after death from this operation, anatomical evidence that the surgeon had made a kind of artificial urethra, i.e. had dissected along the side of the urethra, leaving the stricture on one side only very imperfectly, if at all, divided. The parts should of course be held asunder, and the urethra looked for as carefully as possible. But it is seldom possible to see any distinction between the structures, and the only precaution which can be taken is to keep steadily in the middle line until, possibly, a gush of urine takes place and the director can be passed into the bladder. In any case, even when the surgeon cannot assure himself of the position of the urethra, it is always easy to reach the neck of the bladder by putting the left forefinger on the edge of the subpubic ligament—always easily felt when the tissues of the perinæum have been divided deeply enough—and then entering the knife below it. And I have known a successful issue in such a case, though the surgeon has not been conscious of exposing the vesical portion of the urethra. When the director has been passed into the bladder, a catheter should if possible be conducted along it from the wound,

¹ Mr. Syme used to dwell with characteristic force on the fact, in which all surgeons of much experience in urinary diseases concur, that there are really very few strictures which are impassable, if only the surgeon is dexterous and patient. The necessity for perinæal section ought, to say the least, to occur very rarely.

and tied in. If, however, it is not possible to get the catheter into the bladder at once, the operation may nevertheless be quite successful if only the stricture has been freely divided. The patient should be left alone for a few days, and when the parts have consolidated somewhat, but not so much as to oppose the obstacle of cicatrisation, an instrument will probably be easily passed under anæsthesia. I have followed this course with complete success. The instrument must be changed as often as necessary, at first perhaps every three days, and afterwards every five or seven (an anæsthetic being given if it is absolutely required), until the parts have been completely cicatrised. And after this, as after every other method of dilating stricture, the dilatation must be maintained by the constant passage of instruments.

Cock's
operation
for stric-
ture.

Mr. Cock has warmly advocated,¹ in cases of impermeable stricture, a proceeding which somewhat resembles the early steps of the operation for perinæal section, but which omits the division of the stricture. In this operation, the surgeon passes his left forefinger into the rectum, and by a bold plunge of the knife, directed towards, but not to, the forefinger he endeavours to open the urethra just in front of or just in the prostate gland. This when the urethra is dilated behind the stricture is not very difficult—at least to a practised operator. Then (the finger still being retained in the rectum) a probe-pointed director is passed into the bladder, and a female catheter, or a cannula, or perinæal catheter, is passed into the bladder and secured there. In this way the irritation of the stricture is removed, and the latter may become permeable, and when it is cured in the ordinary way the fistulous opening in the perinæum may be allowed to close. But if the stricture remains impermeable, the perinæal opening must be maintained by passing a catheter through it at frequent intervals, and the patient must be condemned to pass his water through it during his whole life, ‘the man’s micturition being,’ as Mr. Cock expresses it, ‘assimilated to that of the other sex.’ Sexual power will, however, remain (though of course not that of procreation), and Mr. Cock does not consider the persistence of the perinæal fistula as any serious inconvenience. I cannot profess any acquaintance with this operation. We have had a sufficiently favourable experience of the old operation for perinæal section, as described above, at St. George’s Hospital, to adopt it in all cases similar to those which Mr. Cock refers to. It may very possibly involve greater danger to life; but it has the great advantage that when it succeeds (as in the large majority of men with tolerably healthy urinary organs it does) its success is complete, and there is no perinæal fistula, and no deprivation of fertility; besides which it often involves little more incision than Mr. Cock’s operation does.²

Mr. Furneaux Jordan’s proposal³ rests on the same principle as Mr. Cock’s.

¹ ‘Guy’s Hospital Reports,’ 1866. The same operation was, however, recommended and practised at an earlier period by Mr. Simon. See ‘St. Thomas’s Hospital Reports,’ vol. x. p. 139; also ‘Med. Times and Gaz.’ April 1852.

² The urinary organs of a patient who had been operated on many years previously by Mr. Cock were exhibited at one of our Societies some years ago. The urethra had been opened just behind the stricture, which was of very small extent, so that an incision of not more than a quarter of an inch forwards would have enabled the operator to open a healthy portion of the urethra.

³ ‘Brit. Med. Journ.’ Nov. 9, 1872. The principle Mr. Furneaux Jordan advocates is that, in exceptional instances, the ‘membranous’ urethra in some cases, and the bladder in others, is readily opened from the rectum. Only a few lines of tissue separate the finger in the rectum from an instrument in the urethra, the tip of the finger being carried to the depression between the anal sphincter and the prostate gland. In some cases he has found the distended bladder itself coming down to the sphincter; here incision with

He makes a small incision into the distended urethra behind the stricture, which is felt with the finger from the rectum, and then guides a curved flexible bougie through the stricture from behind forwards.

Furneaux
Jordan's
operation.

Mr. Wheelhouse's method¹ of performing perinæal section appears certainly more precise and logical than the old method, which he justly characterises as 'haphazard.'

Wheel
house's
operation.

It requires for its performance only two special instruments, viz. a straight grooved staff terminating in a probe-point which curves slightly to the side opposite the groove, and a probe-pointed gorget. The groove on the staff stops short at least half an inch from the point. The steps of the operation are as follows: 1. To open the urethra well in front of the stricture—say half an inch from it. 2. From this opening to find the orifice of the stricture, pass a director through it, and divide it. 3. To guide a catheter through the stricture from the meatus. The probe-pointed staff is passed down to the stricture, and great care is to be taken that its point is kept in the middle line, resting on the face of the stricture, and is not passed down a false passage. Then the urethra is dissected clean, and opened in the groove of the staff down to the stop at the end of the groove. Now the edges of the opening in the urethra are seized on either side and held open by a pair of nibbed forceps. Next, the grooved staff is turned with its groove away from the operator, and withdrawn, till its probe-point, which hooks away from the groove, catches in the urethral incision and assists the forceps in drawing the walls of the urethra forwards. Now the surgeon has a fair view of the interior of the urethra close to the stricture, and can discover the opening of the stricture with a probe-pointed director which is to be passed through it into the bladder. The surgeon knows that he has reached the bladder by the free movement of the director. He now runs a straight blunt-pointed bistoury along the groove of the director till the stricture is completely divided. Then the probe-pointed gorget is run along the director into the bladder, as a guide to the catheter, which is then easily introduced. In this as in other forms of perinæal section it is of vital importance to see that the whole stricture is fairly and freely divided. The essential point of difference between this and the old operation obviously is the search for the opening of the stricture. Mr. Wheelhouse's description seems to imply that he has never failed to discover it. If the surgeon should be unable to effect this, the second object of the operation, the proceeding would not differ from the old 'boutonnière.'

The complications of abscess and fistula in perinæo are unfortunately very common. The former, however, rarely leads in itself to any graver consequence than considerable pain to the patient and confinement to bed for a time. The abscess in perinæo is rarely of large size. It commonly forms a small, hard, and very painful lump in the central line, much too small and deep to permit any fluctuation to be felt, but known to be an abscess by the presence of stricture, by the pain, and usually also by rigors and other feverish symptoms. No time should be lost in laying it open; it would be very reprehensible to wait until the matter has come forward, and till the surgeon can feel fluctuation. The patient should be brought to the edge of the bed, placed in the lithotomy position, and a deep puncture should be made with a lancet

Treatment
of abscess
in perinæo.

a bistoury would be as safe as puncture with a trocar, and may be followed by the introduction of the finger and the passage of an instrument forwards from the internal meatus to the external.

¹ 'Brit. Med. Journ.' June 24, 1875.

or (better) with a scalpel, great care being taken to keep in the middle line,¹ when matter mixed with urine, and usually very foul, will be evacuated, to the great relief of the patient. It is undesirable to tease him at first with instruments. The urine very seldom comes through the wound, for though the abscess is formed by ulceration of the urethra, its small orifice is generally closed by inflammation; otherwise the pus would flow out by the urethra and there would be little pain and no pressure on the tube, or increase of dysuria. Even if urine do escape, the cure of the stricture will soon cure the fistula.

Treatment
of fistula
in perinæo.

Fistula in perinæo is generally the result of a much more chronic action than abscess. The origin is in some sense the same, but the early stage of abscess is accompanied by more irritation, probably from the greater putridity of the urine; while the fistula results from the gradual extension of ulceration from the urethra to the surface with no increase of the obstruction, and few if any symptoms. These fistulæ accompany all kinds of tight strictures, but are particularly prone to accompany the traumatic, which are the tightest of all. They have been known in such cases to form the only channel for the urine, the urethra being absolutely obliterated. Such unnatural channels, however, can never properly replace the natural urethra; they are very liable to partial obstruction from sabulous deposit, causing low inflammation of the urethra and bladder behind them, and they are a source of great discomfort to the patient, by incapacitating him from passing water in the usual manner. Their cure is to be sought in the restoration of the proper channel for the urine, by passing catheters increasing gradually in size, or by otherwise dilating the urethra to its normal extent. When this is done, the fistula will generally close of itself. If it does not, the reason usually is that a drop of water passes into the urethral end of the fistula every now and then and keeps it irritated. The best way to prevent this is by instructing the patient in the use of the catheter till he can easily pass a full-sized instrument for himself. This he must do every time he wants to make water, and must stop the end of the catheter with his finger as he withdraws it, so that no drop of urine can get into the mouth of the fistula. This plan, if sedulously persevered in for a week or two, can hardly fail to cure the fistula, unless its persistence depends on the chronic thickening and low inflammation of its wall, in which case the tissue should be destroyed by passing a red-hot wire down the fistula, or by passing a wire down the fistula to meet a catheter passed into the urethra and then connecting the wire with the galvanic battery; or sometimes these fistulæ heal on the stimulation of their walls with the tinct. lyttæ, or by means of a probe coated with the nitrate of silver. Possibly in some of these cases a very free division of the strictured portion of the urethra, on Otis's method, so as to dilate it to the extreme capacity of the normal tube in front of it, will enable the fistulæ to heal.² In some very rare cases, a plastic operation may be justifiable. The tissue through which the fistula runs is laid open freely and deeply until the urethra is reached, a grooved staff having been previously passed. All the diseased tissue which can be recognised is pared away and the parts sewn together, a catheter being kept in the bladder. Such an operation, however, is very rarely indeed called for.

Urinary fistulæ may also be produced by other causes, such as the impaction of a foreign body, a wound, as in lithotomy, and in rare cases by the

¹ Perhaps I should rather have said in the raphé, for when extravasation or suppuration takes place on one side, the raphé may be pushed over towards the other side (Harrison's Lectures, p. 25.)

² Teevan, 'Clin. Soc. Trans.' vol. x.

bursting of an abscess into the urethra. I once saw a very healthy-looking man with a large urethral fistula of which he could give no account, except that it appeared to him to have been produced by prolonged sitting on the driving-box, and who certainly had no stricture. In some wounds or injuries of the urethra the tube becomes completely obliterated, and this gives rise to the most obstinate form of fistula.

The most difficult form of urinary fistula to treat is that which opens in front of the scrotum, called on that account 'ante-scrotal' or 'penile fistula.' It is caused usually by syphilitic sores on the skin, which, having become phagedænic, have opened into the urethra, or by sloughing, the result of accident or extravasation of urine. The main obstacle to the closure of such fistulæ is the constant disturbance of their edges by the varying size of the penis in erection, and this is especially the case after plastic operations, for the sutures which have been put in seem to act as irritants, and the patient is very liable to frequent erections. Patience, however, on the part of the surgeon and the patient will usually procure their healing after repeated operations. I once saw a case of ante-scrotal fistula from injury, in which thirteen operations were practised, and ultimately the fistula was perfectly cured. In these cases it is well to dissect up the skin freely around the fistula and to make free lateral incisions, so that the edges of the incision may meet over the fistula without any tension whatever. It may even be necessary to transplant flaps from the neighbouring part of the penis, and to divide the prepuce freely from the glans, in order that the erection of the penis shall produce as little effect on the wound as possible. It seems best to make these flaps double, laying them one over the other as I have described in the operation for extroversion of the bladder (p. 771). Care should be taken to ascertain whether there is any contraction of the urethra, and if so to cure it previously. The wound is to be united either longitudinally or transversely, as may seem to produce least tension on the sutures. The evacuation of the urine is very troublesome after such operations. It is best on the whole, I think, for the surgeon himself to pass a metal instrument three times a day with all imaginable care not to disturb the sutures, and to stop the catheter while he withdraws it. If a catheter is tied in it irritates the wound, and the urine is apt to dribble away beside it. Mr. Clutton recommends opening the urethra in the perinæum before performing any plastic operation for the cure of a penile fistula.¹

Ante-scrotal fistula.

There are cases of urinary fistula with stricture in which the stricture can be passed but cannot be dilated. The patient suffers constantly from rigors after the passage of the instrument, and any progress that may be made at one time is soon lost again. Again, there are other strictures which re-contract rapidly after dilatation, and also hard and dense cartilaginous strictures that refuse to dilate. In such cases the stricture must be divided either by the internal or external urethrotomy.

Recurrent or resilient strictures.

Syme's operation—that of external urethrotomy on a grooved staff—is thus performed. The patient being in the lithotomy position, a 'shouldered' staff is passed into the bladder, i.e. a staff which is narrower at the end than it is in the stem (Fig. 366). We may suppose that the end which passes through the stricture into the bladder is the size of No. 1 or No. 2 catheter, while the stem is the size of No. 8 or No. 10. At the junction of the two parts there will be a projecting 'shoulder,' and this shoulder will necessarily be arrested by the

Syme's operation, or external urethrotomy.

¹ 'Lancet,' Dec. 8, 1883, p. 986.

mouth of the stricture. A groove commences on the shoulder, i.e. on the thicker part of the staff, and runs along the convexity of the staff though not quite to the end. The surgeon passes his left forefinger into the rectum, and passes the point of the knife, with its edge looking upwards, into the raphé of



FIG. 366. Syme's staff.

the perinæum a little above his finger, so as not to wound the rectum, but to open the perinæum deeply and almost expose the staff in the urethra at a single incision, which is to be drawn upwards nearly to the scrotum. The shouldered part of the staff with its groove will now be very perceptible in the wound, and should be further exposed if necessary by a few touches of the knife. Then the point of the knife is to be inserted in the commencement of the groove, where it is, of course, in front of the stricture, and the knife is to be steadily pushed along in the middle line so long as any resistance is experienced. The staff is then to be pushed on until its thick portion will pass freely into the bladder. Great care must be given to this part of the operation to see that the stricture has really been divided quite freely enough; for if this has not been effectually done recurrence is almost certain. Then the staff is to be withdrawn and a full-sized gum-catheter passed from the penis and tied in. There is sometimes a difficulty in introducing the catheter after the withdrawal of the staff. This may be obviated by passing a director from the wound into the bladder before the staff is withdrawn, or by the use of a staff in which the shouldered part screws on to the thin portion, and is unscrewed after the stricture has been divided, leaving the central part to serve as a conducting rod, over which a large catheter open at the end is passed down and the rod withdrawn. But after all it is not a point of very much importance whether a catheter be passed into the bladder immediately after the division of a stricture or not. In a few days, when the wounded parts have a little consolidated, there will be no difficulty in passing the instrument (under anæsthesia if necessary) if only the stricture has been freely divided.

Syme's operation is now used chiefly, if not entirely, in cases of very hard traumatic strictures complicated with fistulæ in perinæo. Such strictures are very difficult to treat by gradual dilatation or by rupture, and are hardly amenable to internal division, though there is no harm in trying this if the surgeon thinks fit. But the free division of all the morbid tissue, and the constant retention of a large-sized instrument afterwards, certainly afford the best prospect of a cure, after which constant catheterisation must not, for many years at least, be neglected.

Rupture or
forcible
dilatation
of stricture.

Another successful method of treating rebellious strictures which admit the introduction of a small instrument is by what is generally called in England 'rupture' of the stricture, and in France 'forced dilatation.' This, however, like every other violent method of treating stricture, should be reserved only for cases of exceptional occurrence, viz. those in which there is unusual suffering from catheterisation, or in which no progress can be made in dilating the stricture, or the patient suffers constantly afterwards from fever and rigors, or after dilatation the stricture immediately recontracts. Numerous plans have been devised for this end. At first, the simple plan was followed of passing a central rod and sliding over it tubes increasing in size till the desired dilatation was reached. This, however, is a very imperfect device,

since the tube is liable to catch and tear the mucous membrane at the site of resistance. Two methods are now employed, in each of which a dilatable instrument is first passed, consisting of two blades, attached to each other at the point, but separable in the rest of their urethral portion and fastened on to a central rod. The dilatation is effected in the one case (Sir H. Thompson's plan) by turning a screw in the handle, which causes a small lever to project from the central stem and so drives the blades asunder. In the other, which is the one in common use, a tube is forced down over the central stem, and thus separates the blades to the required extent. This instrument was invented by a French surgeon, M. Perrève, and has been somewhat modified and introduced into English practice by Mr. Holt, whose name it generally



FIG. 367. Holt's dilator.

bears in this country. Mr. Richardson of Dublin and others have also modified Perrève's instrument. The great risk in the use of any of these instruments is that of passing it down a false passage. In these cases of obstinate stricture there are generally false passages, and sometimes the instrument slips into them so easily, and they run so much in the direction of the bladder, that it is very difficult to know whether the point is in the bladder or not unless the urine can be seen to escape. Accordingly Mr. Holt has had the stem of Perrève's instrument perforated, converting it into a minute tube, through which a drop of urine will escape unless (as frequently happens) the little hole is obstructed by clot; in that case the surgeon should not proceed farther, if there is any question about false passage, until by examination by the rectum and palpation of the abdomen he has completely satisfied himself that he is really in the bladder. The tube is to be applied to the central rod (the handle being opened for the purpose by removing all the screws), and driven smartly home, in doing which the stricture will be felt to give way. The instrument is then withdrawn with the tube still in it, and the urine is drawn off with a full-sized catheter. Two tubes are supplied with the instrument; if the larger one has been used, No. 10 will pass; if the smaller, No. 8. As a general rule the catheter should not be left in, but it is well to draw the water off, both as a proof that the stricture is properly dilated, and in order to spare the patient the pain of passing water soon after the operation. Chloroform may be given or not, according to the wishes of the patient and the surgeon. In very tight and hard strictures it is perhaps necessary, and in all cases where the operation is really required it must be painful, though soon over. The patient should keep to his bed for a couple of days, and then the catheter should be re-introduced and the case treated as an ordinary one of stricture which has been dilated up to that size. It is not always possible, or at least easy, to pass the same catheter as at the time of operation, but in all cases which I have seen (except one of traumatic stricture) the case was very easily managed afterwards.

In this proceeding it seems doubtful what is the real action generally on the stricture. We speak of it familiarly as 'rupture,' but there seems good reason to think that it is often little more than a forcible dilatation, or if there is any rupture it is confined to the submucous tissue, and there is no breach of surface in the urethra. If this is so, it evidently diminishes the risk of inflammation from foul urine being extravasated or passing over a

Internal
urethro-
tomy.

raw surface. The operation is not, however, devoid of danger. The shock resulting from the operation is often severe, and if the kidneys are diseased, as they frequently are, suppression of urine may result. Cases are also recorded where it has been followed by urinary abscess, and even by pyæmia.

Another method of treating rebellious or contractile strictures is by internal division, and this is indubitably superior to rupture in stricture situated far forwards, and possibly in traumatic stricture; though it may be questionable whether in traumatic stricture not in the spongy body the freer division produced by Syme's operation is not preferable. It is performed in two ways, i.e. by incising the stricture from behind forwards, or from before backwards. The former is the safer course, and the one usually followed. Many instruments have been invented for this purpose, but the one most in use is Civiale's, which may be taken as the type of them all. The principle of all is that of the bistouri caché—i.e. a stem containing a knife which is projected by pressing on a handle. In Civiale's urethrotome the head of the

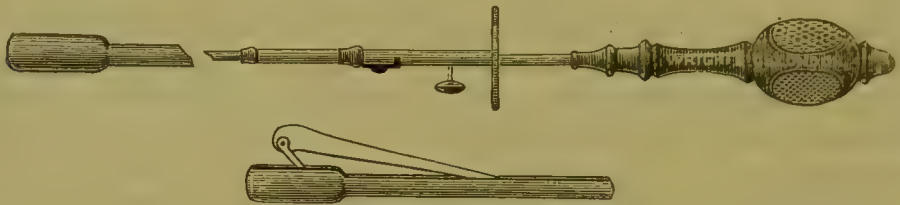


FIG. 368. Civiale's urethrotome.

instrument is bulbous, and in this bulb a small knife-blade is concealed. The position of the stricture is clearly ascertained, and it is felt by the bulb in passing through it. Then as the bulb is withdrawn the knife-blade is projected from it, and the whole tissue of the stricture is freely incised, the incision being directed by preference to the floor of the urethra; and care must be taken that the incision extends completely through the obstruction. After the division a full-sized catheter ought to pass easily, and it is well to retain it for the first twenty-four hours, and to pass instruments frequently afterwards.

Incisions from before backwards require a guide to be passed through the stricture. Maisonneuve's guide is a flexible filiform bougie, on the end of which a grooved rod is screwed. This bougie being passed through the stricture, the grooved rod is screwed on to it, and is passed on. The filiform bougie coils up in the bladder, and guides the rod down the urethra, through the mouth of the stricture. Then a semi-sharp lancet-shaped knife is passed down the groove, which incises or tears the stricture, but is not sharp enough to wound the normal urethra. Sir H. Thompson has devised a grooved catheter for the same purpose, along which a sheathed knife-blade is passed. When this comes to the point of resistance the knife is unsheathed and the stricture divided. A large gum catheter is then passed over the grooved conductor, and the latter withdrawn. Mr. Durham has devised an ingenious instrument in which four small scarificators are projected from an olive-shaped bulb, so as to enlarge the urethra in all directions. The bulb is then passed forwards till it is checked, when the scarification is repeated.¹

The advantage claimed for internal incision over rupture is that its results are said to be more permanent. I have not sufficient experience of the matter to enable me to pronounce an opinion of my own. Sir H.

¹ See a series of papers in the 'Brit. Med. Journ.' March 16, 1878, read before the section of surgery at the Manchester meeting of the Brit. Med. Association in 1877.

Thompson, whose experience of internal urethrotomy extends to above 300 cases, recommends it 'for all non-dilatable strictures situated from two to four inches from the external meatus,' and for these somewhat rare cases I doubt not that it is both safe and easy; but for strictures situated behind the scrotum I should long hesitate before resorting to it, although I do not deny that in rare cases it may be required.¹ In any case it appears that the extent of the incision through the stricture is not in itself a matter of any great importance; but it is highly important to make sure that no part of the stricture is left undivided.

In connection with the treatment of stricture by internal urethrotomy a very interesting question has lately been raised by Dr. Otis of New York. This surgeon teaches that in all cases of long-continued gleet with contraction of the urethra, as evinced by difficulty in passing an instrument, stricture must ultimately result unless the normal size of the urethra (measured according to his method) is restored, for which purpose he recommends internal urethrotomy,² all the contracted parts of the urethra being divided. Mr. Berkeley Hill has given a trial to this method, and the result of his experience is certainly such as will discourage surgeons from acting on a theory which is altogether unproved, and which involves practice evidently dangerous in all cases, and very often quite unsuccessful.³

In some cases in which the limits of the hardened tissue forming the stricture can be felt distinctly under the skin, whether of the penis or perinæum, the stricture may be divided subcutaneously with a tenotome on a catheter staff, over which after the subcutaneous division of the constriction a large rigid catheter can be glided into the bladder. For a description of this operation I may refer the reader to a paper by Mr. Teevan.⁴

In the 'British Medical Journal' ⁵ Mr. Mayo Robson relates a case of recurrence of traumatic stricture after instrumental dilatation, in which he thought it necessary to perform perinæal section, expose the stricture, which was found to consist of a cicatricial band, dissect out this band, and draw the mucous membrane together so as to close the gap thus left. And in the same journal ⁶ Mr. Fenwick refers to other surgeons who have practised the operation. It is recommended as being a radical cure for the stricture, but the only proof afforded was the statement that the contraction had not recurred six months after the operation. The only cases to which the operation would appear to be applicable are strictures of very limited extent, and those which are situated in the penile portion of the urethra, and those are just the ones which are most amenable to treatment by dilatation or internal urethrotomy.

The retention which proceeds from organic stricture is to be carefully distinguished from that which is due to spasm only. To the latter the somewhat incorrect term 'spasmodic stricture' is usually applied. 'Spasmodic retention,' or 'spasm of the urethra,' better expresses the nature of the case,

¹ I would refer the reader to a very interesting little treatise by Mr. Lund on Internal Urethrotomy. See also a clinical lecture by myself, 'Med. Times and Gaz.' July 14, 1883, and Sir H. Thompson's 'Clinical Lectures on Diseases of the Urinary Organs,' 1882, lect. vi.

² Dr. Otis's views and method may be seen described in the 'Brit. Med. Journ.' Feb. 26, 1876.

³ See Mr. Hill's account in the 'Lancet,' April 8, 1876.

⁴ 'Clin. Trans.' vol. viii. p. 65.

⁵ 'Brit. Med. Journal,' March 7, 1885.

⁶ Ibid., April 11, 1885.

Otis's
operation.

Subcu-
taneous
urethro-
tomy.

Excision of
traumatic
stricture.

Spasmodic
retention
of urine.

since there is really no *stricture* in the proper sense of the term. I have already stated that much spasm almost always attends organic stricture, and therefore the retention of urine, as well as the difficulty in passing instruments, in cases of stricture, depends usually to a great extent on spasm induced by irritation of the stricture, or on congestion of the urethra at and near the stricture. But the cases here spoken of are unaccompanied, as far as is known, by any anatomical change in the tissue of the urethra. The causes of spasmodic retention are, gonorrhœa, excesses in drinking, prolonged voluntary retention, the use of cantharides or turpentine, surgical operations about the pelvis, and morbid conditions of the urine; but it occurs also from unknown causes.

It may be known from the retention which accompanies stricture or enlarged prostate by its sudden occurrence, micturition having been quite natural up to the time when retention took place; and from that caused by impaction of stone by direct examination. In some cases, as when retention complicates surgical operations, the history points out the nature of the case.

There is seldom any difficulty in passing a catheter, and as this settles the case at once, and spares the patient a good deal of time and some distress, it is better in ordinary cases to take a medium-sized gum catheter, and pass it rapidly. The muscles may, as it were, be taken by surprise, and the catheter reach the bladder at once. If not, the obstruction will be found to be at the point where the membranous part of the urethra is surrounded by its muscles, and gentle steady pressure for a few seconds will often carry the instrument in. If this attempt does not succeed, the patient should be put into a hot bath till he is nearly faint, having previously had a full dose of laudanum,¹ and then in almost all cases the spasm will yield. In some rare instances it may be desirable to administer an anæsthetic.

Retention
of urine.

Retention of urine is, as will have been seen from the foregoing pages, and from the chapter on STONE, a common symptom of a variety of morbid states. In children, it proceeds most commonly from impaction of a stone in the urethra, or from a ligature round the penis, and in very rare cases from tumour of the bladder or urethra, or from abscess pressing on the urethra. In men, stricture is by far the most common cause, though it may proceed from spasm, or from lacunar or other abscesses pressing on the urethra, from prostatitis, from stone, or in the course of various general diseases. In old age retention is commonly associated with enlargement of the prostate.

Stricture of
the female
urethra.

In the female sex retention is generally due to nervous causes (hysterical retention) or to pressure (as in parturition). It may be caused by stone, and in some very rare cases has been known to be due to stricture. Stricture of the female urethra is an exceedingly rare affection, but does undoubtedly occur. Its usual cause is, I believe, injury in parturition or otherwise. Careful examination is necessary to distinguish it from hysterical retention. It is best treated by rupture or internal incision.

Retention
disting-
guished
from para-
lysis and
from atony
the result
of over-
distension.

Retention from obstruction of any kind (spasmodic or otherwise) must be carefully distinguished in the first place from suppression (p. 770), and in the next place from the kind of retention which is caused by paralysis, and from the atony which follows over-distension. Both of these are succeeded

¹ Sir. H. Thompson says that the Tinct. Ferri Perchloridi in doses of 15 to 20 minims, administered four or six times at intervals of a quarter of an hour, will relieve the spasm. Cazenave recommends the introduction of a lump of ice into the rectum, and I have found this plan succeed.

by overflow of urine—a condition sometimes incorrectly spoken of as incontinence. There is no difficulty in distinguishing between retention from obstruction and that from paralysis. In the former, after the obstruction has been overcome the bladder will discharge its contents with natural force. In the latter (which is very rare, and which is accompanied by other paralytic symptoms) the urine merely runs out under external pressure when the catheter is passed, but there is no muscular action in the bladder itself, and there is no obstacle whatever to account for the retention. Atony from overdistension occurs in numerous classes of obstruction, enlarged prostate, stricture, tumour, &c. After a certain amount of retention, the urine begins to dribble away from dilatation of the neck of the bladder. The treatment consists in relieving the obstruction and keeping the bladder constantly empty.

Incontinence of urine is in the great majority of cases the result of overflow from distension, and ought not to be spoken of as a substantive disease at all, being merely a symptom of obstruction. At other times it means the overflow of paralysis, or of the irritability of the bladder so often connected with paralysis. Hence the first thing in the treatment of incontinence of urine in the adult is to ascertain whether there is not one of those two conditions present, which in the very great majority of cases there is.¹ A very few cases will remain in which the urine, though healthy, cannot be retained for any length of time in the bladder. This happens sometimes in persons broken down by sexual excesses, and in other morbid conditions of the nervous system. The treatment must be regulated by the apparent cause. In some very rare cases of prostatic enlargement incontinence is caused by the projection of the 'third lobe' into the neck of the bladder, keeping it constantly patulous—a condition for which there is no remedy.

Incontinence of urine.

But the condition of pure incontinence which is commonly met with is the juvenile incontinence, or 'enuresis' of childhood, much more commonly seen in boys than girls, in which the child becomes a nuisance to himself and every one else by constantly wetting the bed, and in some severer cases cannot hold his urine in the daytime. In some very rare instances there is also a similar incontinence of fæces. Yet there is no evidence of spinal disease, the urine is natural, and the child in other respects healthy, though many of these children are dull and stupid.

Enuresis in childhood.

In many cases, no doubt, the habit is to be referred to mere wilfulness, and may be corrected by appropriate punishment, or by moral means. It is well known that it is very liable to spread in a school into which a case has once been admitted. But there are many cases in which the child is as desirous to get rid of the infirmity as any one else can be, and I have seen more than one instance in which a ligature has been tied so tight round the penis as to cut into the urethra by a boy who was determined to rid himself of the habit. In these cases the first thing is to make sure of the absence of worms, then to see that the child is awake every three hours and made to pass urine, to act freely on the skin, to give tonics, especially steel and strychnine, and to administer cold douches to the spine. Belladonna is the drug which in my experience has acted most favourably in these cases, beginning with $\frac{1}{8}$ of a grain of the extract three times a day, and raising the

¹ 'There is no principle more important to remember in the treatment of diseases of the urinary organs than this, that an involuntary flow of urine in the adult indicates a distended, not an empty, bladder.'—Thompson.

dose till the characteristic symptoms of poisoning (of which paralysis of the bladder is one) begin to show themselves. Other practitioners speak highly of chloral. Sir H. Thompson says that in obstinate cases the application of a solution of the nitrate of silver, 10 grains to the ounce, to the neck of the bladder, may be beneficial.

The complaint almost always subsides before the patient grows up.

I will merely add that I once saw a case in which the dilatation of the neck of the bladder by a stone projecting into the urethra was mistaken for juvenile incontinence. Of course such an error could only arise from want of examination.

CHAPTER XXXVII.

CALCULUS.

STONE, whether in the kidney or bladder, is produced by the aggregation of some of the ordinary urinary deposits, which we may divide with Mr. Poland into two classes—those allied to the urates and derived from the organic constituents of the urine, and those derived from the inorganic salts of the urine—the phosphates and carbonates. A familiarity with the external appearance of these deposits in the urine, and with their microscopical characters, is necessary for any successful treatment of urinary diseases.

Of these deposits the urates or lithates of ammonia and of soda are the most common. They form a variously coloured cloud in the urine, sometimes pure white, at others almost purple, most commonly yellowish-red, which generally clears entirely on being heated. Such deposits occur constantly as an occasional phenomenon in conditions of perfect health, especially in cold weather, and no importance is to be attributed to the circumstance. But their constant or habitual presence shows that either the digestive or cutaneous functions are disordered, and should induce a strict examination and proper eliminative measures. Lithates.

The microscopical appearances of the lithates are that they either form a completely amorphous deposit, or that, as shown in Fig. 369, there are minute spheres, having protruded from them acicular spiculæ, which are regarded as being those of uric acid.

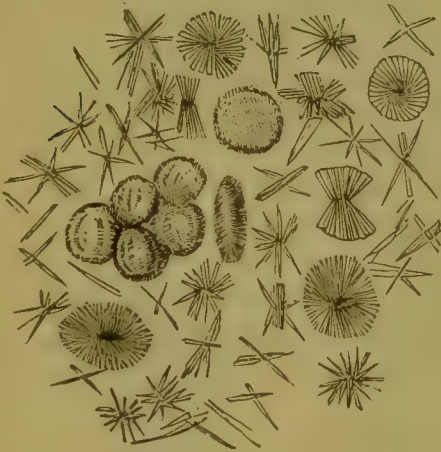


FIG. 369. Lithate of ammonia.

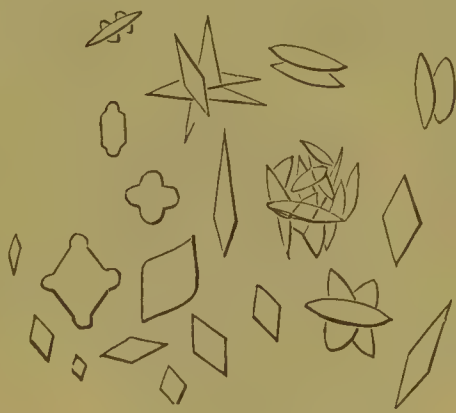


FIG. 370. Uric acid deposits.

Uric acid is also a very common deposit. It occurs in the form of acicular Uric acid. prisms or of rhombic plates, such as are shown in Fig. 370, and these often attain a very large size, so as to be perfectly visible to the eye as 'red sand,' or even to form a minute calculus. Dr. Golding Bird attributes the formation of uric acid deposits to the following causes: '(1) the waste of tissue being more rapid than the supply, as in fever, rheumatism, &c.; (2) the supply of nitrogen in the food being greater than is required for the reparation of the tissues, as in over-indulgence, especially in the use of animal food; (3) the process of digestion being insufficient to assimilate an ordinary

and normal supply of food, as in dyspepsia; (4) obstruction to the cutaneous outlet for nitrogenised secretions, as met with in diseases of the skin, variability of climate, &c.; (5) congestion of the kidneys from injury or disease.' Imperfect respiration is also said to be a cause of excess of uric acid in the urine. The treatment will be regulated by a knowledge of the causes.

Oxalate of lime.

Oxalate of lime is another common deposit in the urine, and often forms a calculus in the kidney or bladder. The microscopic appearances are two-fold—the octohedral crystals (shown on the left of the diagram) and the dumbbell-shaped crystals (on the right). The oxalic diathesis is variously regarded either as being allied to the lithic or the saccharine diathesis—to gout or diabetes. Its causes are either indigestion, exhaustion, or the abuse of saccharine food or fermented liquors. Attention to the cutaneous and digestive functions, the regulation of the diet, and the use of the mineral acids are the main indications of treatment.



FIG. 371. Oxalate of lime deposits.

The rarer deposits in our first class are the *uric* or *xanthic oxide*, which closely resembles uric acid, and the *cystic oxide* or *cystine*, which in external appearance resembles the pale lithates, and under the microscope appears as six-sided prisms superimposed on each other into a mass. This seems to indicate a more profound disturbance of health than the other deposits, and to require more supporting and tonic treatment.

The inorganic deposits are the phosphates and carbonates. The phosphates of soda or of soda and ammonia (alkaline phosphates) which exist in the urine are perfectly soluble and do not give rise to deposits or concretions; but the earthy phosphates—those of lime and of ammonia and magnesia—are insoluble in water, and when set free from their solution in the urine are easily thrown down. This precipitation is readily effected by ammonia; and we have seen above (page 776) that in inflammation of the bladder urea is converted into carbonate of ammonia. Thus a deposit of phosphates is constant in inflammation of the bladder, and many of the numerous causes which diminish or destroy the proper proportion of acid in the urine, as inflammation of the kidney, spinal injury or disease, the ingestion of large quantities of alkali, nervous exhaustion, and many other morbid states, produce phosphatic urine.

Phosphate of lime.

The deposit of phosphate of lime generally occurs as a white cloudy mass, often mistaken for mucus or muco-pus, and as it is precipitated by heat it is often hastily confounded with albumen; but the precipitate is redissolved by acids. It is generally amorphous under the microscope, but it is also found (especially after standing) in the form of spherules, which may coalesce into the form of dumbbells, of glomeruli or rosettes, or of oblique hexagonal prisms (Fig. 372).

Phosphate of ammonia and magnesia.

The triple phosphate of ammonia and magnesia forms large and very conspicuous crystals in the form of triangular prisms, with truncated extremities, or of foliaceous or stellate prisms (Fig. 373). The urine is often very fœtid, frequently acid or neutral.

Both kinds of phosphatic deposit may be mixed in the urine, as they so commonly are in the formation of the fusible calculus.

The carbonate of lime is a rare deposit, which still more rarely collects into a calculus. Under the microscope the deposits may be seen as minute spherules which adhere together something like a drumstick.

These are the ordinary prismatic deposits, but the student must learn also to recognise the various other deposits found in the urine, such as the epithe-

Mixed phosphates.
Carbonate of lime.

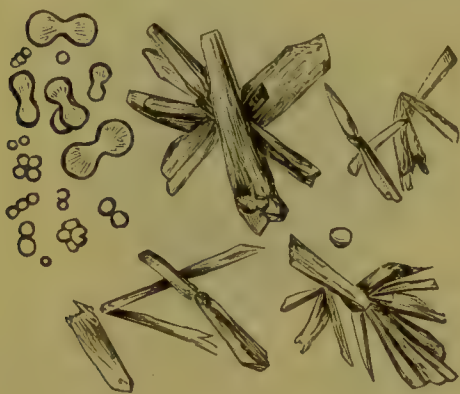


FIG. 372. Phosphate of lime.

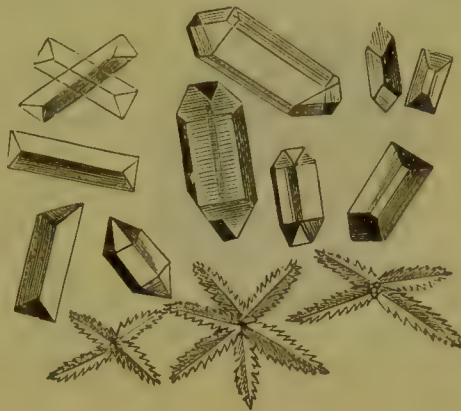


FIG. 373. Triple phosphate.

lium of the kidney or bladder, blood-cells, pus-globules, casts of the renal tubes, spermatozoa, and the various substances which are found in decomposing urine. It is most important to detect the presence of blood-globules, and still more so that of renal casts, as proof of disease of the kidneys.

The kinds of calculi correspond in a great measure to those of the deposits. They are commonly formed in the kidney, and come down into the bladder, where they grow, and sometimes to an enormous size. Sometimes they form in the bladder spontaneously, and at other times are deposited round a foreign body.

Kinds of calculi.

Lithate or urate of ammonia seldom forms an entire calculus except in children, though it is often found as a deposit in the alternating calculi.

Lithate of ammonia.



FIG. 374. Urate of ammonia calculus, from a child aged five. It contains a little uric acid, and traces of earthy phosphates disposed in layers.—From one of Mr. Poland's plates in the 2nd ed. of the 'Syst. of Surg.'



FIG. 375. Uric acid calculus. The external part shows the laminated, the internal, the foliaceous appearance. In the latter situation some oxalate of lime is mixed with the uric acid.—From a plate in Mr. Poland's essay, after a calculus in the Museum of the College of Surgeons.

Urate of ammonia calculi are of a whitish colour, and usually are of an amorphous non-laminated appearance.

The lithic or uric acid is the commonest of all forms of pure calculus. It is of a very hard consistence, and usually of a fawn or brownish colour, though often the nucleus is pure white. The surface is tolerably smooth in most

Lithic acid.

cases. On section it is laminated or radiating (foliaceous). The laminated stones when broken are apt to separate into hard sharp fragments very liable to wound or irritate the bladder and urethra.

Oxalate
of lime.

The oxalate of lime calculus is believed to be the next in frequency after the uric acid. Its peculiar form has given it the name of the mulberry calculus, from the number of small knobs or projections which are found on its exterior, and which certainly present a remarkable resemblance to a mulberry, and



FIG. 376. External view of a mulberry calculus.

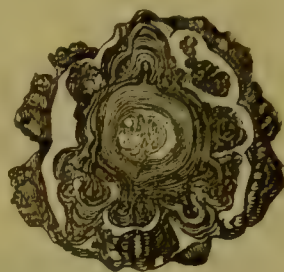


FIG. 377. Oxalate of lime, or mulberry, calculus, showing its internal arrangement 'in an imperfect laminated manner, like fortification agate,' and the deposit of a white material, doubtless phosphates, in portions of its interior.—From one of Mr. Poland's plates.

this is increased by its colour, which usually 'varies from a grey to a rich brown or almost black.' This calculus forms, of course, in acid urine, but it often sets up a good deal of irritation, and then the urine becomes alkaline, and phosphates are deposited on the exterior of the stone.

As rarer varieties of oxalate of lime calculi are mentioned 'hempseed' calculi, small smooth bodies found in considerable numbers in the kidney, and the crystalline calculi of oxalate of lime, which are more or less white.

Xanthic
and cystic
oxide.

The xanthic oxide and the cystic oxide calculi are extremely rare; of the former, indeed, only four specimens were known to Mr. Poland. The cystic oxide calculus is not quite so rare. It is found in the kidney, is often multiple, and there seems some hereditary predisposition to its formation. It is distinguished by its wax-like lustre on fracture, by its containing a good deal of sulphur, and by its changing colour with age from a pale yellow to brown, grey, or green.

Phosphate
of lime.

Phosphate of lime calculi are chiefly found deposited around a nucleus of some other substance, which may be a lithic acid or oxalate of lime calculus, or may be a foreign body. It is usually of vesical origin, and forms a confused mass, not laminated, but 'resembling mortar, or a granular semi-crystalline powder, enveloped in a tenacious mucus.' These are the 'bone-earth' calculi; but there are others of renal origin, consisting of neutral phosphate of lime, which are 'pale brown, with a smooth polished surface regularly laminated.'

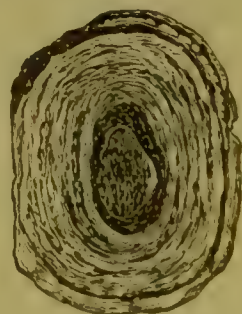


FIG. 378. Phosphate of lime calculus, formed round a nucleus of lithic acid, showing the laminated variety of the phosphatic calculus.—After one of Mr. Poland's plates.

Triple
phosphate.

The triple phosphate does not very commonly form a calculus by itself. There are only three specimens in the Museum of the Royal College of Surgeons, and one or two at Guy's Hospital, one of which is figured by Mr. Poland—a remarkable specimen, in which the triple phosphate has been deposited round a piece of tobacco-pipe.

But the majority of phosphatic calculi are of the mixed kind, and these

mixed phosphatic calculi have the remarkable property of melting in the blowpipe flame, from which circumstance the concretion has received the name of the 'fusible calculus.'

Many calculi are of the 'alternating' variety—in fact, few are absolutely pure; but in those properly called alternating, the condition of the urine has varied during the period of growth of the stone, so that the calculus is composed of definite concentric layers of different deposits alternating with each other. In a very great majority of cases the external layers are formed of the phosphates; and phosphatic calculi are very seldom succeeded by any other form.



FIG. 379. Alternating calculus. The nucleus is urate of ammonia, mixed with oxalate of lime; this is followed, first, by oxalate of lime, secondly by uric acid, and lastly, by alternate layers of urate of ammonia and earthy phosphates.—After Poland.

Carbonate of lime calculus is exceedingly rare in the bladder, but the small concretions which are often found in the ducts of the prostate sometimes consist almost entirely of this substance, and are usually exceedingly numerous.

There are various forms of pseudo-calculus, or concretions of organic matter.

These are the fibrinous, consisting of condensed fibrine or albumen; the urostealith, consisting of small collections of some resinous or fatty matter; and 'blood calculi,' composed of the remains of blood-clot, with some phosphate of lime. But their occurrence is so very exceptional that they are of little practical importance.

The following table was drawn up by Dr. Bence Jones as containing the easiest and most practical directions for the chemical examination of urinary calculi:—

A. Destroyed by heat; combustible; leaving only a small residue.

1. Become red on the addition of nitric acid, and form a murexide.

a. Soluble in carbonate of potash, evolving no ammonia; soluble in caustic ammonia or potash; on the addition of an excess of acid crystallises in angular crystals, not soluble in water. } Uric Acid.

b. Soluble in carbonate of potash, evolving ammonia; soluble in water when boiled; solution in water with a few drops of ammonia, when evaporated, crystallises in needles. } Urate of Ammonia.

2. Do not become red on the addition of nitric acid.

a. Soluble in ammonia, not crystallising when evaporated; insoluble in carbonate of potash; dissolves without effervescing in nitric acid, leaving a lemon-coloured residue; soluble in strong sulphuric acid, not precipitated by dilution. } Uric or Xanthic Oxide.

b. Soluble in ammonia, crystallising in six-sided plates when evaporated; soluble in strong caustic potash; the solution when boiled for a few moments, on the addition of a drop of dilute acetate of lead, gives sulphuret of lead. } Cystic Oxide or Cystine.

c. With difficulty soluble in ammonia, not crystallising; with nitric acid becomes bright yellow; solution in caustic potash precipitable by acetic acid in an amorphous form; emits an odour of burnt feathers on ignition. } Fibrinous.

B. Not destroyed by heat; non-combustible; leaving a considerable residue.

Fusible calculus.

Alternating calculi.

Carbonate of lime.

Pseudo-calculi.

Tests for calculi.

1. Soluble with hydrochloric acid; effervesces before heating; soluble in mineral acids without effervescence; solution in acid, when neutralised, gives a precipitate with carbonated alkalis and oxalate of ammonia; soluble in dilute acetic acid with effervescence. } Carbonate of Lime.
2. Soluble with hydrochloric acid; effervesces after heating; soluble in mineral acids without effervescence; solution in acid when neutralised gives a white precipitate with carbonated alkalis and oxalate of ammonia; insoluble in acetic acid; decomposed by strong sulphuric acid, yielding carbonic acid and carbonic oxide; and when boiled with carbonate of soda, oxalate of soda is found in the solution and precipitated by chloride of calcium. } Oxalate of Lime.
3. Soluble with hydrochloric acid; do not effervesce either before or after heating.
 - a. Solution in acid with excess of ammonia gives a white crystalline precipitate; with half its bulk of phosphate of lime (bone-earth) is very fusible before the blowpipe, and gives off an ammoniacal odour; dissolves in acetic acid without effervescence. } Phosphate of Ammonia and Magnesia.
 - b. Solution in acid with excess of ammonia gives an amorphous precipitate; with twice its bulk of phosphate of ammonia and magnesia is very fusible before the blowpipe. } Phosphate of Lime.
 - c. Solution in acid with excess of ammonia gives a white, partly crystalline, partly amorphous precipitate; without addition easily fusible before the blowpipe. } Mixed Phosphates.
4. Not acted upon by acids or alkalis; fused with twice its bulk of carbonate of soda forms glass. } Silica.

Calculus
in the
bladder.

Calculus in the bladder is a complaint which affects all ages and both sexes; but by no means equally. Males are far more liable to be affected than females at all periods of life. This seems due chiefly to the differences in the urethra of the two sexes; for although at a late period of life we could suppose that differences in habits might account for it, yet no such cause can be imagined in infancy, where, however, the exemption of females is quite as striking. And renal calculus, which is the first stage of most cases of vesical calculus, is common enough in the female. The cause of stone is at present unknown. It is far more common in some parts of England than in others, and far more common in some foreign countries than in any part of England;¹ but the reason for the difference is not apparent. If there is any determining cause in either the air, water, diet, or habits of the natives of the affected districts it has not as yet been satisfactorily pointed out. Sedentary habits, indulgence in acid intoxicating drinks, and all other causes which favour the deposit of uric acid or oxalate of lime in the urine, may, of course, lead to their deposit in such quantity as to form a stone. Phosphatic stones also form in the kidney under any conditions which increase the elimination of phosphates, and in the bladder from any inflammatory condition, especially when a nucleus is present on which the phosphates may be deposited; but why stone should form in little children who seem to have no reason for any such formation, why it should be so comparatively common in the children of the poor and almost unknown in those who are better fed and tended, and why it should prevail among children in one district while it is hardly ever seen amongst those similarly circumstanced and fed in another part of the country, are questions to which no answer has as yet been given which has commanded universal assent, or which has assumed any practical importance.

¹ So frequent is it in the North-Western Provinces of India, that I have been assured by a surgeon stationed there that he has operated eight times in the same day.

The symptoms of stone in the bladder are very much the same whatever the composition of the stone may be, though the rougher and more angular the stone the more pronounced will be the symptoms. They are pain; which is of two kinds: first, a sharp cutting pain towards the termination of, or immediately after, micturition. This is especially referred to the end of the penis, and is due to the sensitive mucous membrane contracting on the stone. It is often in children the cause of their frequently pulling the prepuce so as to produce considerable elongation of it. In cases where the stone is encysted or the prostate enlarged, this variety of the pain due to calculus may be absent, and is often much relieved by causing the patient to pass his water in a recumbent position. Secondly, there is a constant chronic pain in the region of the bladder and perinæum, often radiating and extending down the back of the thighs, especially if the stone is large, when it is produced by mechanical pressure on the nerves of the sacral plexus. There is usually pain on making any active exertion, such as running or jumping, or jolting in a carriage; though this is not always the case, and pain is sometimes absent in cases of very large stones, if they fill the bladder and cannot be moved about, unless they cause pain by pressing on the sacral plexus. Blood in the water is, I believe, a symptom always present at some period or other of every case of stone, though it may be absent at the time when the case is under examination. The hæmaturia generally consists in the passage of a few drops of bright blood after the act of micturition, and is caused by the calculus bruising the walls of the bladder when they contract upon it. There is increased frequency of micturition, and this is especially noticeable during the day whilst the patient is moving about, and is not a prominent symptom at night, when the patient is quietly at rest and the stone remains in one position. In this it differs from the increased frequency of micturition in cases of enlarged prostate, which is especially troublesome when the patient is warm in bed. It is due in the first instance to irritation of the walls of the bladder from the calculus; later on to cystitis. In some cases there is the history of a sudden arrest or cessation of the stream of urine during the act of micturition. This is produced by the stone rolling to the neck of the bladder and mechanically obstructing the orifice of the urethra. It may usually be overcome by a change in position on the part of the patient; i.e. by his assuming the recumbent position, when the stone will roll away again from the orifice. There is often a good deal of straining at stool, leading to prolapsus of the rectum in children. Finally, sooner or later cystitis will be set up, and will be attended with a great aggravation of the symptoms. The desire to pass water will be greatly increased, and various morbid products will be found in it; blood will appear in larger quantities; pus and mucus also will be present. Many of these symptoms, however, may be produced by mere irritation of the bladder, and the evidence of the sound is necessary before we can pronounce definitely on the presence of stone. And even this is not always conclusive. There may be a stone, but from some accidental implication in the walls of the bladder, or from its being contained in a cyst (as in Fig. 392), the sound may fail to strike it.¹ The latter is a very rare complication, but the former is common enough. We constantly see patients who have been sounded, and the surgeon has felt the stone; but on proceeding to operate he cannot feel it. Believing that either the stone has been

Symptoms
of stone.Ambigui-
ties in
sounding
for stone.

¹ Cases also have been recorded where the stone has been so covered over by soft semi-solid matter from the bladder that it has not been detected by the sound. See Harrison, 'Lectures on Disorders of the Urinary Organs,' p. 157.

passed by the urethra, or that he has made a mistake, he puts off the operation, and the next time, or even after several such trials (I have known as many as five), the stone has been felt and removed. When therefore the symptoms are well-marked, the surgeon should not too confidently pronounce that there is no stone merely because he cannot feel it. Again, there have been cases (and I confess it has occurred to myself, even when assisted by very able colleagues) in which the sensation communicated to the sound by something lying outside the bladder has so exactly resembled that of a stone that the bladder has been cut into and no stone found. This mortifying error is caused by the sound striking some point of bone—I believe, generally the spine of the ischium; others say the sacro-vertebral angle. Bearing this in mind, it is unsafe, I think, to operate for stone unless, as well as the sensation, the ring of the stone has been heard, or the stone has been felt (as it sometimes may) with the finger in the rectum. The ring or sound communicated to the instrument by striking a stone is of course decisive. It varies in loudness. When a large hard stone (as of uric acid) is fairly struck with the point of the sound it rings so loudly as to be audible at a good distance; when the calculus is soft and phosphatic, or the sound cannot be removed freely in the bladder, the ring will not be so distinct.

Forms of
the sound.

A few words may be useful about sounds. The instrument in common use is a solid polished steel bougie, the shape of a common catheter, made in one piece with a smooth flat handle. It has the disadvantage that in consequence of its comparatively large curve the point is directed so far upwards that it might ride over the stone and fail to strike it; especially if there be any enlargement of the prostate, behind which the stone lies in a kind of pouch. Then, again, it is often desirable, if the stone has not been hit at once, to vary its position by emptying the bladder, or, on the other hand, to distend the bladder with water, and so disengage its walls from the stone. All these desiderata are accomplished by the beaked catheter-sound. This is a catheter with a small bore and an enlarged or 'lobbed' extremity. It has the length and the curve of a lithotrite; i.e. it is straight till within about one and a half inch of its end, where it is turned up so as to form a 'beak.' There is a stopcock near its handle, and the handle itself is a sort of flat shield on which the finger and thumb can easily rest, and can accurately appreciate sensations from any object which the beak may touch. The smallness of its shaft as compared with its end renders it much more movable in the urethra and neck of the bladder than the common sound is. If introduced with the stopcock closed, it acts as a common sound, but its small end can be more easily applied to every part of the bladder, or can be reversed so as to feel behind the prostate. By opening the stopcock it is converted into a catheter, and as the bladder is emptied the stone often drops down and the sound touches it, and then if the surgeon thinks right an injecting syringe can be applied, and the bladder filled to distension and carefully investigated.

In sounding a patient, he should be laid on his back, with a thick cushion under the buttocks, so as to raise the pelvis and cause the stone to roll towards the upper part of the bladder, where it is most easily detected. The surgeon should stand on the left side of his patient, and if there is any difficulty in finding the stone, the forefinger of the left hand should be introduced into the rectum, which will much facilitate the exploration. In fact, in the majority of cases, if the stone is of any size it may be felt through the rectum by the finger with the greatest facility. I have felt, in a child, a stone not much bigger than a pea by this means. In the event of the surgeon

being unable to detect a stone, and the rational symptoms are well marked, he should not give a decided opinion on the case, but should repeat his examination on some future day. For it will often be found that a stone which cannot be detected at a first exploration may be on some subsequent occasion.

Calculi are often numerous, and it is very desirable to ascertain if possible with some approach to precision what the size of the stone is, and whether there is only one or several in the bladder. An experienced surgeon will usually form a tolerably correct idea of the size of a stone from striking it, and examination with the sound will sometimes enable him also to guess at the presence of more than one stone, but the only sure way to ascertain either of these particulars is to sound with the lithotrite. By catching the stone in one or two positions an accurate idea of its size is obtained, and often the surgeon having one stone in the grasp of the forceps can distinctly ascertain the presence of another.

Methods of appreciating the size and number of stones.

The endoscope, a tube illuminated by a lamp at its extremity and closed by a piece of glass, was introduced some years since as a means of looking down the urethra and seeing the face of a stricture or the wall of the bladder, and some surgeons have professed thus to be able to determine the presence, nature, size, and number of foreign substances in the bladder; but the difficulty of the investigation is so great, and the portion of tissue seen at one time is so minute, that I believe I am not wrong in saying that the endoscope has been for some time generally disused. Recently, however, an improved instrument has been invented by Leiter of Vienna, by which an electric illumination of the male urethra by means of a new incandescent lamp can be made, which with longer cannulæ might be made available for exploration of the bladder.¹

The endoscope.

If the symptoms of stone be allowed to persist unrelieved the patient usually dies from general disorganisation of the urinary organs, the result of obstruction and inflammation; sometimes from pyæmia, brought on by phlebitis of the veins around the prostate; sometimes by ulceration and perforation of the bladder.² In any case the mode of death is a very painful one, and it is desirable to attempt the removal of the stone even in cases where the surgeon feels that there is but little chance of success.

Terminations of stone.

Two methods only are at present known for removing calculi. Chemical solvents have been sought for centuries; sometimes it has been believed that the discovery has at last been made; the electric current also, it has been imagined, might be used for their disintegration; but hitherto all such plans have failed, and though it seems most probable that ultimately stones will be dissolved in the bladder, we have at present to deal with lithotomy and lithotrity.

Operations for stone.

The preference of one method to the other is regulated on some such general rules as these:—

Comparison of lithotomy and lithotrity.

1. In male children lithotomy is very successful—in fact so successful that until very recently lithotrity has scarcely ever been resorted to and has been regarded as not very appropriate, in consequence of the small size of the urethra and the irritability of the bladder. Within the last few months,

¹ See a paper by Mr. Hurry Fenwick, 'Brit. Med. Journ.' March 3, 1888, p. 462.

² Stones have been known to travel by ulceration through the bladder into the scrotum or perineum, from which they have been extracted by an incision.

however, Surgeon-Major Keegan,¹ Mr. Walsham,² and others have strongly advocated litholapaxy, as employed by Bigelow in the adult for stone in young children. The chief arguments in favour of this operation which these surgeons deduce are—(1) the absence of the risks attending all cutting operations; (2) the rapidity of the cure, the patient being, in the great majority of cases, convalescent the day after the operation; (3) the advantage that the genito-urinary organs remain intact, and the danger of emasculation in consequence of interfering with the ejaculatory ducts is avoided. This latter advantage does not apply, of course, in cases of supra-pubic lithotomy; but in these cases it is said that litholapaxy possesses the special advantage of the absence of all after-annoyance from the urine escaping through the supra-pubic wound, should primary union not occur. The recorded cases have abundantly proved that the operation can be performed without great risk, and that the objection which has been raised that the urethra and bladder in the child are too small to permit of the manipulation of the necessary-sized instrument can no longer be urged; but I think we require a more extended experience before definitely determining to abandon lithotomy in the majority of cases of stone in early life. I have no doubt that the prolonged operation and the amount of injury which may be done to the coats of the bladder will produce in some cases special dangers, which may be found, with a more extended experience, to counterbalance the advantages which are claimed for litholapaxy, and I am still of opinion that for stones of any considerable size in childhood lithotomy is the best and safest course.

2. Stricture of the urethra does not prevent the operation of lithotrity. For if the symptoms are not urgent the stricture may be first cured and then the operation of lithotrity proceeded with. Mr. Buckstone Brown,³ in cases of stone with long-standing organic stricture, recommends rapid dilatation by means of a series of conical highly polished steel sounds, and then lithotrity at a single sitting. If, however, the stricture is associated with an irritable condition of the urethra and bladder, it is highly unfavourable for the success of the crushing process, and the operation is not to be recommended. Enlargement of the prostate, especially if only moderate, does not contra-indicate lithotrity, though it may be an element in the judgment which the surgeon will form in a dubious case.

3. Lithotrity has no chance of success in patients suffering from extensive renal disease. It is true that such patients usually die after lithotomy, but if it is judged necessary to perform any operation at all, lithotomy is on the whole the best.

4. In cases of very large or very numerous stones the lithotrite may perhaps not have room to work. Such cases must be dealt with by lithotomy, and even when the stone does not fill the bladder, but still is so large that it would require numerous sittings, and the patient is at all irritable, it is doubtful which is best. The composition and hardness of the stone were questions of much importance in the old method of lithotrity by repeated sittings, since a large concretion can be rapidly broken up if it consists chiefly of soft phosphates, and the débris will pass with but little pain; whereas a uric acid

¹ 'Indian Medical Gazette,' 1884-86. Of 42 cases all the stones were removed at a single sitting, except in one case, which was the only fatal one. Here the stone was formed round a piece of wood, a fact which would have contra-indicated lithotrity if it had been known. The boy died after the third attempt. All the patients were under twelve years of age. Twenty were under six. The youngest was only one year and nine months old.

² 'Clin. Soc. Trans.' vol. xix. p. 240.

³ 'Lancet,' Nov. 10, 1883, p. 810.

or oxalate of lime stone is broken into sharp fragments, many of them of considerable size, very apt to lodge in the urethra or to inflame the coats of the bladder.

The operations of lithotomy are numerous. The one most frequently adopted in England is the lateral operation, which accordingly I shall describe. Lateral lithotomy.

The perinæum is to be shaved if necessary. The staff is then to be passed, and the patient is to be drawn to the edge of the table with the but-

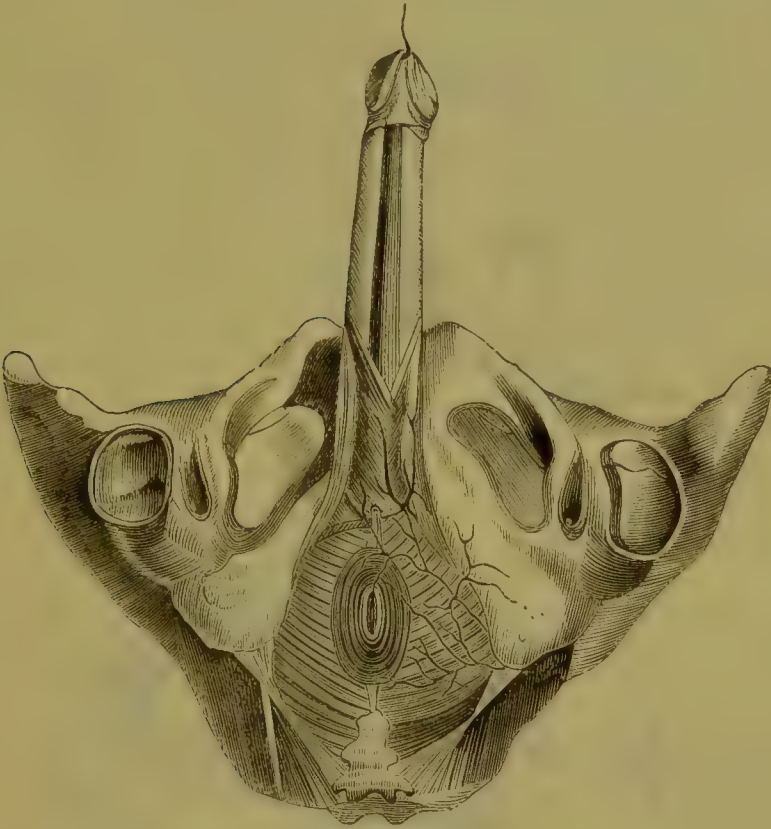


FIG. 380. A dissection of the perinæum, showing the position of the bulb of the urethra and the floor of the ischio-rectal fossa. (After Pirrie.) The incision in lateral lithotomy is commenced just over the bulb, but the operator makes that part of the incision superficial, so that the bulb and its artery escape. He divides the floor of the ischio-rectal fossa (the anterior fibres of the Levator ani), and reaches the membranous part of the urethra, as shown in the next figure.

tocks slightly projecting over the edge, the feet and hands secured together, the hand grasping the dorsum of the foot. They are secured either with the garters or shackles.¹ The knees are held apart, the patient's body kept quite

¹ The 'lithotomy position' is used in many operations on the genital organs both of the male and female. Three methods are in use for maintaining the patient in this attitude, i.e. in the sitting posture with the feet grasped in the hands, and the knees widely separated. 1. The lithotomy-garters, two bandages of some firm webbing about eight yards long and terminating in a loop. The whole bandage is first passed through the loop, and into the loop so formed the forearm is passed and it is drawn tight. Then the hand is made to grasp the foot and the bandage is wound around them in successive turns of figure of 8, and the end firmly pinned. 2. The 'shackles' consist of a leather foot-piece securely laced over the ankle, and a leather band around the wrist. To the foot-piece is attached a ring, and to the wrist-piece a hook. The pieces are put on while the patient is taking the anæsthetic, and when he is insensible he is put in the proper position and the hook passed into the ring. 3. Mr. Clover invented a very handy crutch—a piece of iron about two feet long, ending at either side in a bend to which a strap is attached. The thighs being flexed on the abdomen and abducted, are supported by the bent ends, and prevented from moving by the straps, and thus are kept bent and open. Of the three plans the shackles are much superior to the lithotomy garters, being less

perpendicular to the table, the staff held vertical by a steady assistant, with its point well in the bladder, and if possible resting on the stone. Then an incision is made from the left side of the central point of the raphé to the point midway between the anus and the tuber ischii and drawn backwards into the ischio-rectal region as far as is judged necessary. This incision should divide the skin and superficial parts. The surgeon then puts his left forefinger into the upper angle of the wound, deepens the incision till he can distinctly feel the groove of the staff, puts the point of his knife into the groove, and then pushes the knife on till it reaches the bladder. Having reached the bladder he withdraws the knife, enlarging the wound a little as he does so, by lateralising the edge of the knife and pressing it a little on the parts. Then he pushes his left forefinger along the concavity of the staff till it reaches the bladder, which it will do if he have made the wound free

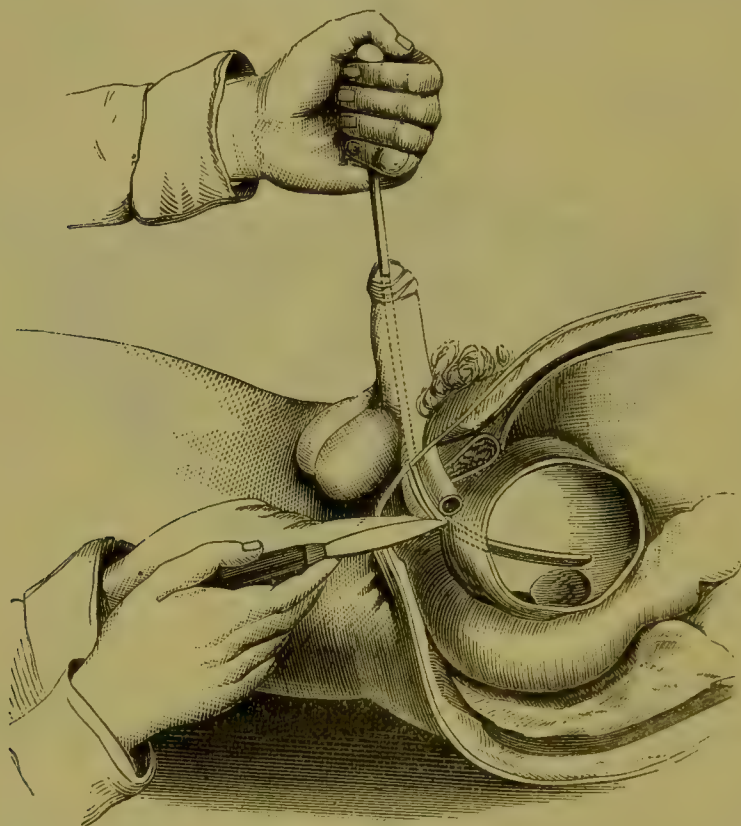


FIG. 381. The second step of the operation for stone. The knife entering the groove of the staff in the membranous portion of the urethra.—After Pirrie.

enough. Having placed his forefinger on the stone he withdraws the staff, and passes the forceps along the upper side of his finger. When the forceps have reached the bladder he opens the blades, and then a gush of urine occurs. The stone is often thus carried into the grasp of the forceps; otherwise it must be felt for, the forceps applied to it (taking care that the coats of the bladder are not caught also), and the stone then withdrawn in the axis of the pelvis. If it is not very large there is no difficulty about this; but if it is, gradual dilatation of the wound with the stone and forceps by a sort of corkscrew motion is necessary. After the stone has been removed the bladder should always be carefully searched to see whether there is another.

troublesome to apply and more secure from slipping. Mr. Clover's crutch is very easily and quickly applied, and answers its purpose very well; but does not, I think, keep the patient quite so steady. When none of these apparatus is at hand common bandages will do very well, applied like the lithotomy garters.

A few words about each step of this operation are necessary.

In the first place, it is essential that the stone should be felt with the staff itself upon which the surgeon is to make his incision. It is not enough that a calculus has been felt on the previous occasion, nor even with another instrument while the patient is on the table. In order to be certain that the stone is really present and the staff properly lodged in the bladder, the stone should be struck with the staff itself.

As to the shape of the staff there are different fashions. Most surgeons use a staff of the same shape as a catheter. At Guy's Hospital, the 'straight' staff (which, however, is not accurately straight) is preferred, the supposed advantage being that there is less risk of the knife slipping out of the groove. But as this ought never to happen in careful hands, and the straight staff is more difficult to find in the perinæum, I fail to see any advantage which it has; nor can I see the necessity of making the groove on the side instead of in the centre of the staff. The rectangular staff was for some time in favour with some good surgeons, but, I believe, is now generally disused. It has the great drawback of being very awkward to pass, and very liable, therefore, to make a false passage—a drawback very imperfectly counterbalanced by its advantage, that its angle is easily found in the perinæum.¹ As for the position of the staff in the bladder, some surgeons direct that it should be inclined to the left side, in order to present its groove more readily to the operator. This seems to me a matter of indifference; the main point is that it shall be steady and not slip out of the bladder, and this, I think, is best secured if the assistant holds it vertically, hooking it against the pubes.

The main dangers in the operation are as follows:—

There may be unavoidable hæmorrhage from some unusual distribution of the arteries. This proceeds generally from the internal pudic furnishing an accessory internal pudic, instead of bifurcating in its usual position under cover of the ramus of the ischium, or from an abnormal course of the artery of the bulb. Again, very free hæmorrhage may take place in old persons from the veins about the prostate and neck of the bladder. The only thing that can be done is to tie any divided artery if possible, or, if the vessel cannot be secured, to hasten to complete the operation, and then plug the wound with 'the petticoat plug,' i.e. a large catheter or tube passed through a piece of stout cloth into which a quantity of lint is pressed sufficient to fill and make considerable pressure on the sides of the wound. Avoidable hæmorrhage proceeds generally from the artery of the bulb if the wound be deepened too much at its front part, for it must be recollected that the incision commences over the position of the artery. But in children this artery is so small that its division is of no consequence; in fact, I believe that it is almost always divided. It is said that the internal pudic may be cut if the incision is extended too far outwards; but this seems impossible if the artery occupies its natural situation, and probably in the cases in which this has happened the artery has been abnormal. The great danger in lithotomy is, that the urethra should be broken across and pushed before the finger into the pelvis; or that the knife should leave the groove of the staff, and so the incision be made, not into the bladder, but between it and the rectum. In either case the surgeon does

Dangers
of the
operation.

¹ If the rectangular staff is ever to be used, the apparatus invented by Dr. Buchanan should be employed. In this apparatus, after the staff is lodged in the bladder a director is fixed on to it which terminates in a point. This point pierces the perinæum and is received into a hole in the angle of the staff. The surgeon has now nothing to do but follow the groove of the director straight into the bladder.

not reach the bladder, and I have seen cases in which an inexperienced lithotomist under these circumstances, believing that he had reached the bladder, withdrew the staff, and in one case was obliged to give up the operation altogether; in another, completed it by the help of a senior colleague, but with great risk and difficulty. This is avoided by making the incision into the staff free enough to admit the finger, and never letting the point of the knife quit the groove as it is being pushed into the bladder, nor taking the staff out till the finger is in actual contact with the stone. One of the great difficulties in lithotomy in little children is to make the incision large enough to admit the finger without wounding the rectum or other parts around. Much has been said as to the danger of incising the whole of the prostate and thus laying open the cellular tissue beneath the recto-vesical fascia, whereby it is supposed the urine from the bladder is admitted into the meshes of the cellular tissue, infiltrating it and producing diffuse cellulitis. This doctrine rests on high authority, yet it has been much questioned. In children the whole prostate must necessarily be divided, for the gland is too small to allow an entrance to the bladder otherwise; yet children never suffer from the diffuse suppuration which is supposed to be the result of such division. The danger of urinary infiltration in lithotomy consists in opening up the recto-vesical fascia, where it forms the lateral true ligaments of the bladder, and so permitting the infiltration of urine to take place into the loose sub-peritoneal tissue. An incision may therefore be carried through the prostate up to the very neck of the bladder without doing any harm, provided that it does not pass up to the recto-vesical fascia; and though it is, no doubt, prudent not to carry the deep incision further than is absolutely necessary, yet it appears to me safer in the case of large stones to make a sufficient incision than to lacerate the prostate and the neighbouring tissues, as is often done in such cases. For small stones a very moderate incision, dilated by the forefinger, suffices; for larger calculi a freer cut is required, or, if the stone sticks in the incision, a blunt-pointed straight bistoury may be passed along it and the constricting parts nicked here and there.

When the finger is placed on the stone, the latter may be so small and smooth as not readily to be grasped by the forceps. The scoop is then very useful. This is an instrument exactly resembling a small spoon with a very long handle. It is slipped under the stone, which is held in it by the forefinger.

When the operation is over some surgeons always pass in a straight tube, which is tied in; but this is not necessary, except in order to repress hæmorrhage, as stated above.

The rectum is to be unloaded before the operation, and will then almost certainly escape injury if the surgeon is moderately dexterous. A gentle purge should be given on the second night before operation, and the lower bowel should be completely emptied by an injection exhibited about eight hours before the operation. This will both unload the bowel and prevent the patient being disturbed for a day or two afterwards.¹ If it should happen that the rectum is injured the wound in it should be united if possible, and may very probably heal; otherwise the resulting fistula is very intractable (see below).

The after-treatment is very simple. The urine runs into some tow or carded oakum placed beneath the patient and frequently changed; and if he is irritable he is to be kept tolerably under the influence of opium.

¹ In children the rectum often protrudes during the operation. This gets it more out of the way, and the advice usually given to repress the prolapsus is undoubtedly wrong.

The main causes of death after lithotomy are pyæmia, hæmorrhage, peritonitis, diffuse inflammation, and sinking from renal disease. The operation, particularly when protracted, as in the case of very large stone, may prove fatal by the immediate shock.

Causes of
death after
lithotomy.

The danger of the operation depends mainly on three things: the state of the general health, and especially of the urinary organs, the age of the patient, and the size of the stone. In persons of almost any age, who are of sound constitution, and in whom the kidneys are healthy and the bladder not extremely degenerated, lithotomy is a very successful operation. In children death is very rare; the small proportion (about 5 per cent. on an average) who die being chiefly weakly infants exhausted by previous suffering or labouring under visceral disease. But when the stone is of large size and there are evidences of very acute inflammation, that inflammation has usually extended to the ureters and kidneys, and any slight injury would probably prove fatal; still more the formidable operation by which alone a large stone can be removed. The inference is, that no delay is admissible in cases of stone. When the symptoms become more accurately known to the public, and the necessity of seeking competent advice at an early period is generally recognised, stones will be disposed of when of small size by lithotripsy, lithotomy in the adult will become an even rarer operation than at present, and stone will be only rarely a cause of death.

After the operation for stone, a fistulous communication may be left between either the bladder or urethra and the rectum. The latter is far more common, for the wound in the neck of the bladder generally heals, and the patient regains the power of retaining his urine; but it passes into the rectum and becomes a source of constant annoyance and irritation. Recto-urethral fistula occurs also (as mentioned above) from prostatic abscess, though rarely; and I have known it follow on too free incisions for anal fistula. It has been known also as a consequence of ulceration of the urethra behind a stricture, or as a complication of stricture of the rectum. The cure is by no means easy. If the catheter can be passed into the bladder without going into the rectum, the urine should be drawn off in this way every time the patient wants to make water, or he should be instructed always to make water lying on his face; and a few weeks' perseverance in this treatment may be successful—the edges of the fistula being stimulated with the tinct. lyttæ or the galvanic cautery. But, unluckily, it is only in rare cases that this can be done. In some cases a cure may be obtained merely by stimulating the edges of the sinus with the galvanic cautery, with or without division or stretching of the sphincter ani.¹ On the failure of such measures a plastic operation is necessary, and this, of all other plastic proceedings, seems to me one of the most disappointing. It may be performed in one of two ways. The patient (under chloroform or not) is placed in the prone position with his legs separated and hanging over the table. A duckbill speculum in the rectum exposes the fistula, which is to be pared and its edges united, and a catheter passed into the bladder and kept open, so that the urine shall flow out constantly. If this fails the surgeon may lay the parts freely open into the anus, endeavour to separate the urethra from the rectum, and unite the tissues over a catheter passed into the bladder, so as to close the urethra and leave the rectal wound to granulate. I have, however, treated, and seen others treat, these fistulæ after lithotomy, and, I confess, with very little success.

Recto-
vaginal,
and recto-
urethral
fistula.

¹ See Birmingham, 'New York Med. Journ.' Feb. 1886.

Median
lithotomy.

The lateral operation appears to me to be the best suited for all ordinary cases. In some instances, however, where the stone seems impacted in the urethra or neck of the bladder (as seen in Fig. 394), the median operation (which often bears the name of Mr. Allarton, in consequence of his having revived it and recommended its general adoption) may be preferred, and it is also an easy and ready way of removing small stones in childhood.

A grooved staff is passed into the bladder; the left forefinger in the rectum feels the groove just as it disappears in the prostate gland. The surgeon plunges the point of his knife into the groove, at or near this point, holding the edge upwards, and taking care not to perforate the rectum. He pushes the knife on a little way so as just to nick the prostate gland, and withdraws it, making at the same time a free division of the raphé of the perinæum, leaving a conical wound, at the bottom of which the groove of the staff is exposed. A director is then passed along the groove of the staff into the bladder, and when the stone has been felt with this director the staff may be withdrawn. A pair of dilating forceps are passed along the director, and the wound dilated until the finger passes into the bladder, when the operation is completed in the usual way.

Other
methods of
perinæal
lithotomy.

The aim of the operation is to avoid the danger, or supposed danger, of incising the prostate. Its drawback is the difficulty of removing anything like a large stone through the wound without a most injudicious amount of violence. Other surgeons join with a lateral or median incision of the perinæum incisions into the prostate gland, made by means of a *lithotome*, which is a bistouri caché with one or two blades, made to project at different angles so as to incise both lobes of the prostate horizontally (Boyer); or with a curvilinear incision on each side (Dupuytren); or horizontally on one side and obliquely on the other (Senn); or obliquely upwards and downwards on both sides (Vidal de Cassis). Such operations are known as bilateral lithotomy. Others, again, make the incision in the middle line of the perinæum while incising the prostate with the knife in various directions. But these operations are little if at all practised in this country, experience having shown to the satisfaction of the great majority of surgeons that the lateral operation is, on the whole, the best; as affording more room than any of the others if the stone be large, and being equally safe, if not more so, when it is small. It is true that it has its difficulties and dangers, but they seem, on the whole, less than those attending on the other methods.

Rectal
lithotomy.

It remains to speak of two plans which are occasionally resorted to, viz. rectal lithotomy, and the hypogastric or supra-pubic operation. The recto-vesical operation is now only used in this country as a last resource, when the stone is too large to come through the ordinary incision and the operator cannot break it,¹ and consists merely in extending the incision into the rectum as far as is judged necessary. This may sometimes be the operator's duty; but in a case which I once saw, and which in other respects was quite successful, a fistula was left between the urethra and rectum which could not be closed. The old recto-vesical operation (which was, I believe, frequently adopted by Mr. Lloyd of St. Bartholomew's Hospital) was commenced in the rectum. It resembled the median operation to some extent, but the surgeon, instead of plunging his knife into the urethra in front of the prostate, passed it with his left forefinger into the rectum, pierced the wall of the rectum and urethra or neck of the bladder, and then cut outwards in the middle line, through the external sphincter and perinæum.

¹ See a case by me in vol. xxv. of the 'Path. Trans.'

The hypogastric or supra-pubic operation has recently been brought prominently into favour, and has been strongly advocated by Sir. H. Thompson

The hypogastric or supra-pubic operation.

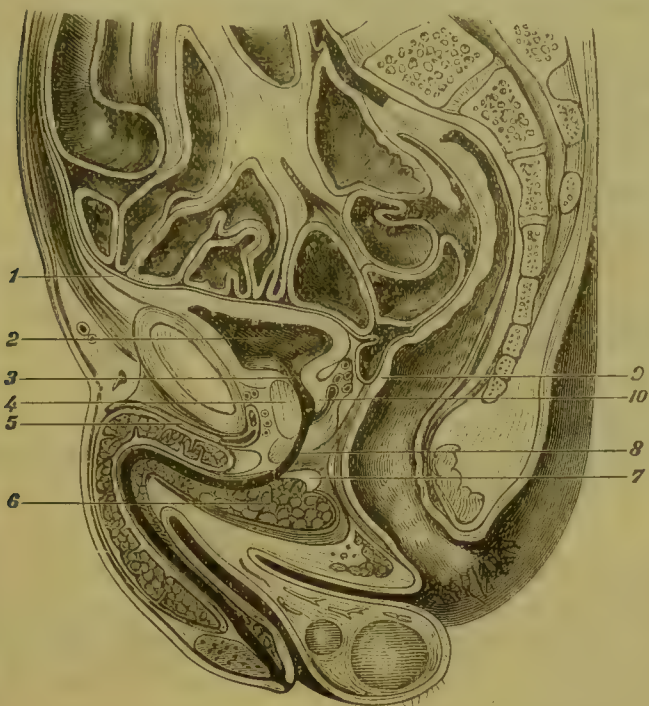


FIG. 382. Longitudinal section through a frozen body with the rectum filled (naturally) but not distended.

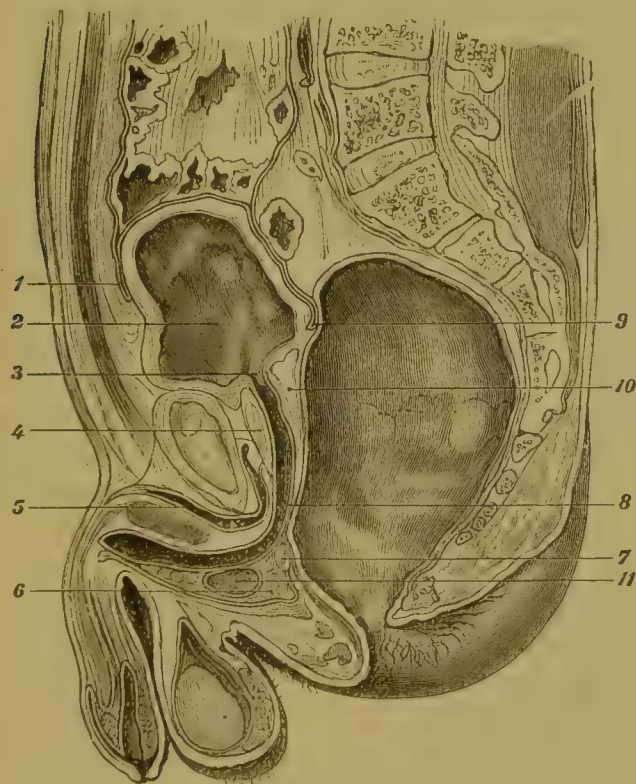


FIG. 383. Longitudinal section through a frozen body with the rectum much distended (artificially).

1. Peritoneal fold, passing over the bladder from the abdominal walls.
2. The bladder.
3. Internal orifice of urethra.
4. The prostate.
5. Dorsal vein of penis.
6. Bulbous portion of urethra.
7. Cowper's glands.
8. The upper end of the membranous portion of the urethra.
9. Recto-vesical fold of peritoneum.
10. Prostate.
11. Abscess in bulbous portion of urethra. From Garson, 'On Displacement of the Bladder and Peritoneum in the Male by Distension of the Rectum,' *Edinb. Med. Journ.* Oct. 1878.

and others in cases of large stones, and for the removal of tumours of the bladder in both sexes.¹ The main danger in the operation is that of wounding the peritoneum, and this is best avoided by distending the rectum with an india-rubber bag, introduced empty, and then filled with 12 to 14 ounces of water. This (as Dr. Garson has shown) elongates the prostatic urethra (see Fig. 383), lifts the bladder out of the pelvis, and pushes the peritoneum out of the way. The bladder also, in the male, is to be filled with about 8 or 10 ounces of some antiseptic solution (5-per-cent. solution of boracic acid), and then appears plainly above the symphysis pubis to the sight and touch. An incision about three inches long can then be made through the linea alba and transversalis fascia, the veins and cellular tissue over the bladder scratched aside with the finger, a sharp hook passed into the bladder to prevent its retraction, and the bladder opened in the neighbourhood of the hook sufficiently to admit one forefinger; this is followed by the forceps and the stone extracted. Should the opening be too small, it may be enlarged by dividing the coats of the bladder towards the os pubis with a probe-pointed bistoury,

¹ 'The Supra-pubic Operation of Opening the Bladder for Stone and for Tumour.' London, 1886. See also papers by Mr. Barwell, Mr. Rivington, and Mr. Jacobson in '*Med.-Chir. Trans.*' vol. lxxix.

till the stone can be withdrawn without violence. The wound in the bladder may then be stitched up, but it seems on the whole preferable to leave it open and insert a large drainage-tube, but even this does not seem to be absolutely necessary. All that is requisite is to apply a large sponge squeezed out as dry as possible in a 1-in-40 solution of carbolic acid, and change it every hour.

In the child, Mr. Annandale,¹ after distending the bladder thoroughly (but not the rectum), introduces a lithotrite and seizes the stone. He then cuts down on the bladder, and, depressing the handle of the lithotrite, causes the stone, which is grasped in the blades of the instrument, to present in the wound, covered by the coats of the bladder. The bladder is now opened and the lithotrite with the stone pushed through the wound. When the stone has been disengaged from the lithotrite, the latter is used to convey an india-rubber catheter through the urethra. This is left in the bladder, the wound in which, if large, may be stitched with one or two sutures, and if small left alone. Then the wound in the parietes is united, a drainage tube being inserted at its lower end. The same method Mr. Annandale believes to be applicable in the adult.

It is impossible at present to arrive at any positive conclusions relative to the application of the supra-pubic operation; though there are certain cases where its performance is undoubtedly expedient, as in calculi which exceed a certain magnitude, or in cases of ankylosis of the hips, which would prevent a complete exposure of the perinæum.

In cases where the stone is too large to be extracted, it must be broken down by a kind of lithotrite or forceps before its fragments can be brought out of the wound. Various contrivances have been invented for this purpose, and it is well to have an instrument of the kind at hand when the stone is suspected to be very large; but operations on such complicated cases are rarely successful. Lately Professor Dolbeau of Paris has introduced, as a substitute for lithotomy in general, an operation which he calls 'perinæal lithotrity.' As this operation has not yet obtained a recognised place in surgery, I cannot describe it minutely. It consists in making a small median opening into the membranous part of the urethra, dilating successively the external incision—the urethral opening—the deeper part of the urethra—and the neck of the bladder—seizing and breaking the stone—extracting the pieces, and carefully washing out all *débris*. The operation requires peculiar instruments and various precautions, for which I must refer the reader to Prof. Dolbeau's work, '*La Lithotritie Périnéale*,' or a short account by Dr. Ewart in the '*Lancet*' for October 17, 1874.

Perinæal
lithotrity.

Lithotrity.

Lithotrity is the operation by which the stone is broken in pieces in the bladder, and the pieces either extracted at the time through the urethra or allowed to come away with the urine. Until the year 1878 the old method of lithotrity consisted in performing the operation at several sittings, with the smallest possible amount of manipulation and leaving the passage of the fragments as much as possible to nature. But in that year Professor Bigelow, recognising the fact, which had already been pointed out by Otis, that the urethra was capable of great dilatability, and availing himself also of the principle of suction which Mr. Clover had already demonstrated as useful, in his ingenious apparatus for removing *débris* from the bladder, introduced a new system of operating by which the stone was removed at a single sitting by means of evacuating-tubes connected with a suction-bottle by which

¹ '*Brit. Med. Journ.*' Oct. 9, 1886.

the crushed fragments were at once drawn from the bladder. This proceeding has revolutionised the whole operation of lithotrity, and the old operation has now become almost obsolete and has been superseded by the new method, to which the name of 'litholapaxy' has been given.

I will first describe the new operation with evacuation, as I believe that it will soon entirely replace (as it already has done in the practice of the most experienced surgeons in this operation) the old method of lithotrity.

The lithotrite (Figs. 384, 385, 386) is a pair of forceps the shape of a catheter, only with much smaller curved end and curving more abruptly,

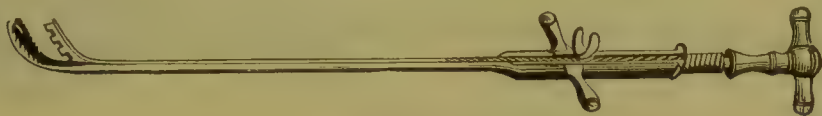


FIG. 384. The common screw lithotrite. The male blade is opened and shut by the lunate catch seen on the handle, and when the stone is firmly caught the screw is driven home. The female blade is usually perforated by a large opening ('fenestrated') in order to avoid the jamming of fragments in the blades. When it is intended to use the lithotrite as a scoop and remove the fragments this blade is not fenestrated.



FIG. 385. Civiale's lithotrite. By turning the two little buttons on the handle horizontally, the male blade is detached from the screw, and made movable. When the stone is caught the buttons are turned vertically, and then the screw will act on them.



FIG. 386. Thompson's lithotrite. The fluted cylindrical handle affords an easy hold for the surgeon. Pressure on the button in the handle disengages the screw. The object of these newer forms of lithotrite is to enable the surgeon to grasp the stone and set the screw in motion with less manipulation, i.e. less change of position of the hands, than in the common screw lithotrite.

one blade of the forceps (the male) being received into the lower or female blade moving in a groove by means of a handle and shutting down by a screw.

The object of lithotrity is to catch the stone between the two blades of the lithotrite without injuring the walls of the bladder, and then, by forcing the male blade through it, to fracture or crush the stone, and by repeating this operation break it down into pieces small enough to pass through the evacuating-tubes and be extracted by the aspirator.

Lithotrites are made with the female blade fenestrated, half-fenestrated, or non-fenestrated. Probably, as Sir. H. Thompson observes, for a small or medium-sized stone, a light, half-fenestrated instrument is the best. In this the upper part of the blade is flat and crushes the stone into small fragments, while the lower portion is fenestrated and prevents the possibility of blocking by débris. In very large calculi a fully fenestrated instrument is desirable.

The evacuating-tubes are merely large-sized, thin-walled catheters, with a large eye on their anterior aspect. They are generally made in three sizes, corresponding to Nos. 14, 16, and 18 English gauge. They are fitted with a flexible stylet, which permits of their more easy introduction, prevents a fold of the mucous membrane of the urethra catching in the eye of the instrument, and serves to free the tube of any débris which may collect in it. They are made either straight or slightly curved at their extremity. The former are much to be preferred when they can be passed, as the fragments find their way through them with greater facility, but the curved tubes are the easiest to introduce.

Of the different forms of aspirators Clover's original instrument (Fig. 387)

is a very useful one, and combines simplicity with efficiency. Sir H. Thompson's possesses, however, some advantages, and is perhaps better adapted for the purpose, since it is provided with a tap with a funnel-shaped opening at the upper part of the india-rubber ball, by which water can be introduced, or air, which has been accidentally admitted, got rid of. Moreover, it is fitted with a hanging wire valve, which prevents the regurgitation of débris into the bladder (Fig. 388). The urethra should be previously dilated, if

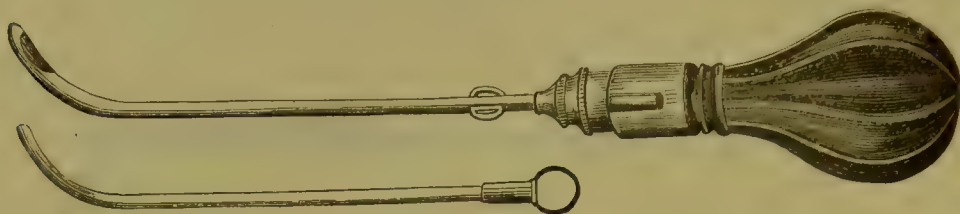


FIG. 387. Clover's syringe. The india-rubber ball is filled with water. This is injected into the bladder with the instrument as nearly vertical as may be. Then the ball is allowed to expand, drawing the water and fragments of stone up the eye of the instrument. The fragments fall into the glass receptacle by their own weight, and the process can be repeated several times without any risk. If a fragment too large to pass should fall into the eye of the catheter it must be dislodged before withdrawing the instrument. This is accomplished by passing the stem figured below the catheter.

necessary, until it will easily admit a large instrument. It is not necessary, as it used to be in the old operation, to ascertain beforehand that the passage of instruments is well borne by the patient. The general health being ascertained to be good, and all other indications being favourable (see p. 819), the process should be commenced. Anæsthesia having been induced, the patient is laid on a hard mattress with a firm cushion under his buttocks and his shoulders low. The knees are raised and widely separated, and supported in this position by assistants. Care must be taken to protect the trunk and extremities from cold by wrapping them in blankets. It is not necessary to inject water into the bladder as used to be done, but at the same time it is desirable that the bladder should not be entirely empty, and the patient may be instructed not to pass his water for an hour or two, if he can conveniently retain it, before the operation. The lithotrite is to be passed fully into the bladder before it is opened. Then there are two different methods of catching the stone. Both are in use by most eminent and successful operators, and it seems clear to me that they are about equal in value. The most important matter is to acquire dexterity by constant practice in the method selected. The one which is commonly called the English, or Sir B. Brodie's, method (Fig. 389) consists in sinking the closed lithotrite to the base of the bladder, when, if the instrument be opened to its full

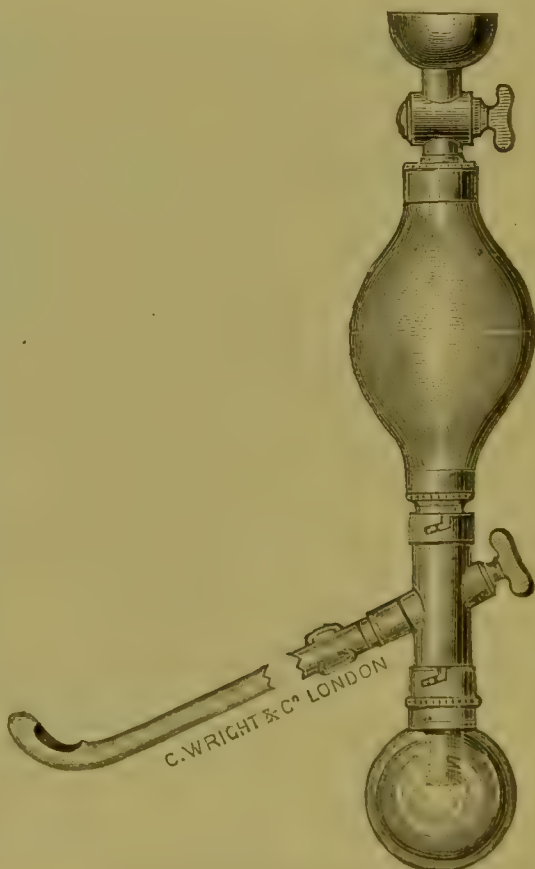


FIG. 388.—Thompson's aspirator.

extent, the stone will usually fall within its blades, especially if the patient's pelvis be moved or slightly shaken; or if the handle of the lithotrite be lightly tapped. The other method—the French, or Civiale's—consists in feeling the stone with the lithotrite as with a sound, and then gently inclining the instrument away from the stone sufficiently to open the blades, which are then to be applied to the stone (Fig. 390). This may be necessary when the stone lies partly or entirely behind the prostate. When the stone is grasped and the male blade securely screwed down on it, the lithotrite should be moved a little way so as to make sure that it is free of the wall of the bladder, and then the instrument is closed and the stone crushed. When this has been once done, there is generally no difficulty in picking up and

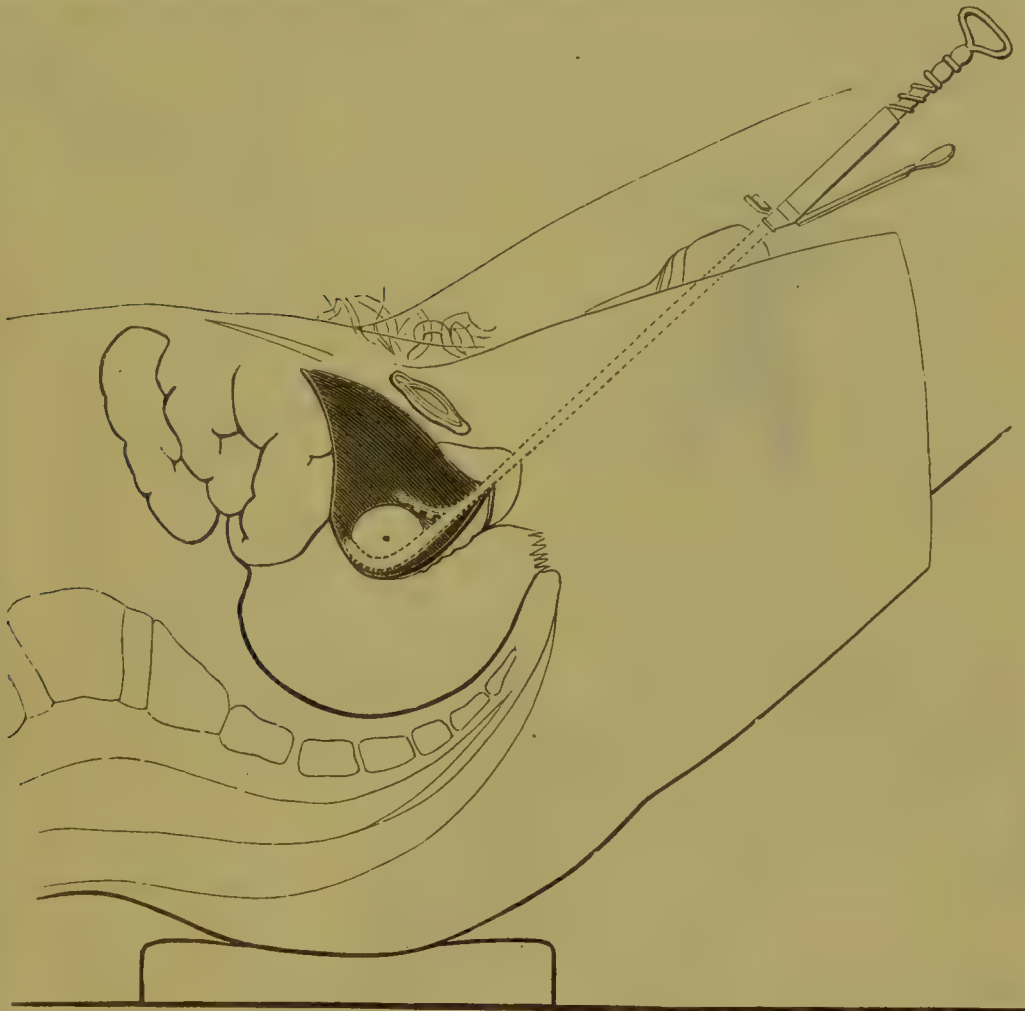


FIG. 389. The English, or Brodie's, method of lithotripsy. The lithotrite has been passed to the base of the bladder, and the stone allowed to fall into its grasp.—After Sir H. Thompson.

crushing other fragments, and this should be continued until no further pieces can be found. When this has been done, the lithotrite is withdrawn and the evacuating tube passed. To this the aspirator, charged with warm water, is connected and the water forced by sharp, quick strokes into the bladder. On its return it carries with it the *débris* of the stone, which falls into the glass receiver. Sometimes the india-rubber bottle does not expand freely; this is due to a piece of calculus or a clot of blood obstructing the tube. This can often be removed by a more forcible compression of the bottle; but if not, the aspirator must be disconnected and the tube cleared with the flexible stylet. When the water returns through the tube free of *débris* or fragments, it is withdrawn, and the lithotrite again

used. And in this way, by three, or at the most four, alternate crushings and evacuations, the bladder is entirely freed of its foreign body. The best test that the bladder is empty is the evacuating-catheter used as a sound; so long as any considerable fragment too large to pass through the tube remains in the bladder, it is sure to be felt striking against the catheter, as the water rushes out of the bladder on relaxing the pressure on the india-rubber bottle, unless it has become entangled in the folds of the bladder or become enveloped in a clot of blood or mucus. Under these circumstances probably it is impossible to detect it.

After the operation the patient should be warmly wrapped in blankets and a morphia suppository placed in the rectum. The diet for a few days

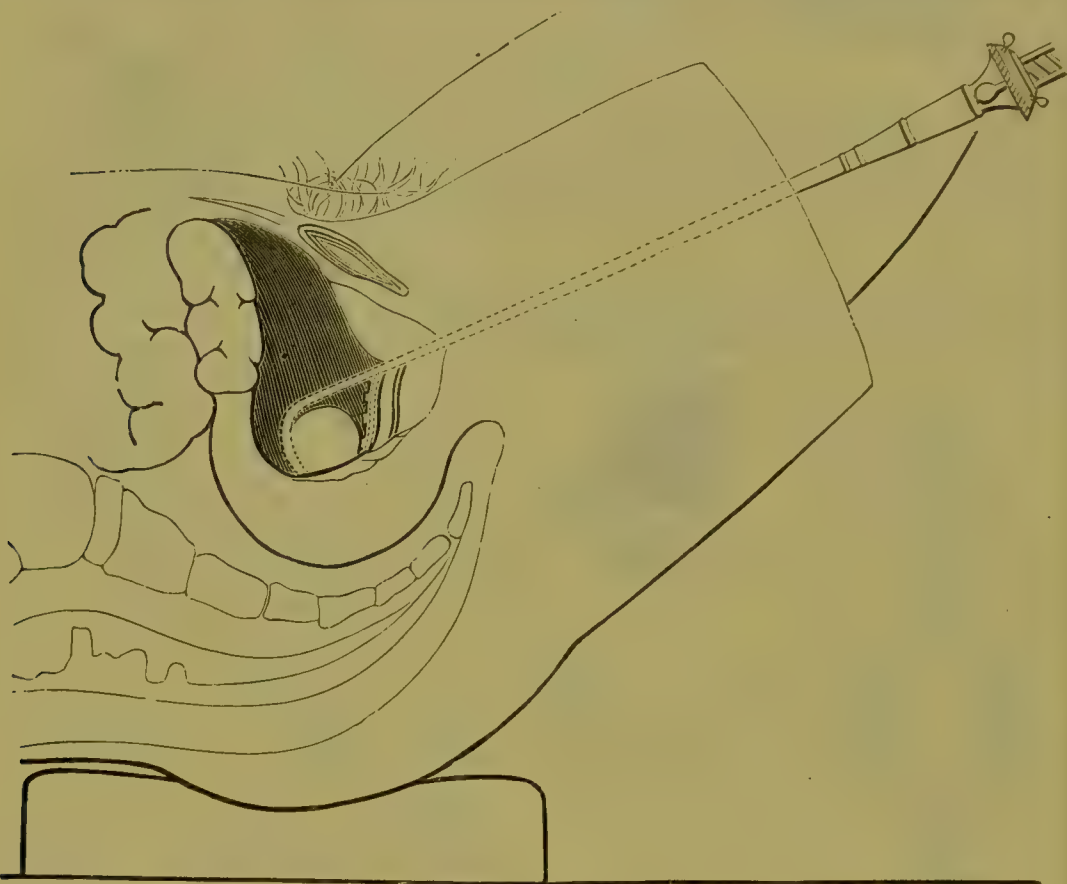


FIG. 390. The French, or Civiale's, method of lithotritry. The lithotrite is reversed to seize a large stone.—
After Sir H. Thompson.

should be moderate, milk forming the principal article of food, with plenty of demulcent drinks, such as lemonade or barley-water.

As regards the success attending the system of treating all calculi but the very largest by lithotritry at a single sitting, Sir H. Thompson,¹ writing in 1884, says that since 1878, when he commenced practising this method of operating, he has adopted the system in every case in which lithotritry appeared to be possible, with two exceptions only. The total number of cases was two hundred and eleven, with seventeen deaths, or eight per cent. The mean age of these patients was over sixty years. Several of the stones of uric acid, and one of oxalate of lime, were considerably over an ounce in weight. The largest uric acid calculus which he removed at a single sitting weighed $2\frac{3}{4}$ ounces.

With such experience, to which the favourable testimony of many other

¹ 'Brit. Med. Journ.' July 12, 1884, p. 53.

operators may be added, we can hardly doubt that the removal of the stone by lithotrity and aspiration will to a great extent supersede not only the older methods of crushing, but also lithotomy in the numerous cases in which it used to be recommended merely on account of the size of the stone. The protracted manipulation needed to remove the stone in such cases appears to be a necessary evil more than counterbalanced by the total removal of the stone without any wound. Yet it would be idle to deny that such protracted manipulation must necessarily involve danger. I have seen a patient die with suppuration in the pelvis in whom the operation had been performed quite satisfactorily—although here there was, no doubt, disease of the kidney. But it should be recollected that disease of the kidney is a very frequent concomitant of stone in late life. Great success can only be obtained by delicate manipulation. The instruments should not be larger than necessary, and need not for ordinary stones exceed in size, or indeed differ in any respect from, those in previous use, except perhaps in the shape of the aspirator, which is now provided with a trap for catching the fragments more conveniently formed than that attached to Clover's instrument. The length of time required for even a large stone need not usually exceed an hour, though a much longer time has been consumed in cases which have turned out quite well; so that it is better to persevere as long as may be necessary rather than leave any fragment behind.

The old method of performing lithotrity may still be preferred in some cases. It is undoubtedly a less formidable proceeding and is easier of performance, and as regards the results there would appear to be little difference between the two.

The old operation.

In this operation the stone is seized and crushed, as in the other method, but it is not prudent at first to proceed too far.

As a general rule about three actions of the lithotrite will be enough at first. If the patient bears the operation well, more may be done at subsequent sittings. The administration of chloroform or ether is not, ordinarily, necessary, since the operation, if dexterously done, does not give much pain; but if the patient be nervous there is no objection to it. Some surgeons, and especially Sir W. Fergusson, have recommended the withdrawal of such fragments as can be extracted by means of a scoop; but the general opinion is that if the operation is not to be finished at a single sitting, it is on the whole better to allow the fragments to pass of themselves, and to avoid all manipulation which is not absolutely necessary. The sittings may be repeated at intervals of five or six days if there have been no bad symptoms, or even more frequently.¹

In cases which do well the patient passes the stone in small fragments with little or no inconvenience, until ultimately the nucleus comes away and his symptoms are relieved; but there is often a good deal of trouble in deciding whether there is a small fragment left in the bladder or not, and it is obvious that there may be cases in which the detection of a single fragment may be well-nigh impossible. Thus the bladder may be fasciculated as in Fig. 391, and it will be easy for a fragment to slip into one of the pouches between its muscular fibres, where it will be very difficult to strike it. For the purpose of disengaging such fragments, the bladder is to be filled with a large quantity of water before searching in a doubtful case.

Or it may even happen that there is a definite pouch in the bladder, as in

¹ It would, however, be better to use Bigelow's method in all cases of this description in which the patient can bear protracted anaesthesia.

Fig. 392, when the surgeon will naturally believe that he has removed all the fragments, and the patient will suffer from no symptoms except when the stone happens to escape from the pouch. Such cases are very difficult to treat, but they are rare, and in ordinary instances there is no difficulty either in determining the presence of a fragment or in detecting and crushing it.

Sir H. Thompson says:—‘As long as any remain, there will almost invariably be pain in passing water, especially at the close of the act, while the urine may be cloudy, and often tinged with blood, and quick movements of the body give pain. As long as these symptoms persist we may be assured some portions still remain behind, and these must be found.’

Complica-
tions.

The bad symptoms which sometimes follow lithotrity are as follows:—

1. Inflammation of the bladder may be produced by unskilful manipulation, or even when all possible skill has been exercised the cystitis previously existing may be aggravated either by the necessary operation or by the sharp edges of fragments. This may run the usual course of cystitis and subside, leaving the patient in a condition to continue the treatment, or



FIG. 391. A fasciculated bladder, having in the interstices of its muscular coat a number of lithic acid calculi, some of which appear to be partly adherent to the coats of the bladder.—From a preparation presented by Sir B. Brodie to the Museum of St. George's Hospital, Ser. xii. No. 30.



FIG. 392. Impaction of fragments of calculus in a pouch of the bladder after lithotrity.—St. George's Hospital Museum, Ser. xii. No. 34.

perhaps in the surgeon's judgment rendering a resort to lithotomy preferable.¹

2. Enlargement of the prostate gland may cause much difficulty in passing the fragments, which will be detained in the bladder, irritating it and propagating inflammation to the kidneys. In rarer cases the same effect is produced by partial paralysis, or by atony, of the bladder. Clover's syringe, or some other form of aspirator, is peculiarly useful in all these cases.

3. The plexus of veins which surround the neck of the bladder may be irritated and inflamed, and this may prove the starting-point of general pyæmia. I have seen pyæmia prove fatal in a chronic form, even in a case where the stone had been very small and had been entirely crushed and removed. A small ulcerated surface existed in the bladder, which had doubtless been produced by the stone itself, as the patient had complained of acute pain for a long time before the operation, especially after making water.

¹ In many cases, however, when the irritation is considerable but the patient otherwise in a good state, it is best to crush the larger and sharper fragments at once, and this will relieve the cystitis.

But I have also seen pyæmia come on in the acutest form and prove fatal in a week.

4. The impaction of fragments is one of the most dreaded sequelæ of lithotrity. It is the opinion of some of the best authors that this impaction

hardly ever happens unless the urethra has been lacerated, i.e. that a fragment which is small enough to pass into the urethra will be passed on by the walls of the canal if they remain perfect, however sharp its edges or angles may be. This does not, of course, apply to the meatus, which is much smaller than the rest of the urethra. It often happens that the nucleus or last fragment of the calculus lodges there, but this merely requires that the meatus should be incised and the fragment removed. The fact that impaction is far more frequent when the urethra has been lacerated constitutes a grave objection to the proposal to remove the débris in the lithotrite-scoop immediately after crushing.¹

When a fragment is impacted, retention of urine and pain will be produced. Retention, however, occurs sometimes without any impaction. Sometimes the fragment comes so far forwards as to be felt from the surface, more commonly it is buried in the perinæum. In the latter case, if the symptoms are not very urgent, the warm bath and opium will sometimes enable the patient to make water and bring the fragment forwards, when possibly it will pass without further trouble. If the fragment is lodged near the neck of the bladder, it may be gently pressed back with the lithotrite and crushed at once. If further forward than the scrotum, it may be extracted by means of the urethra-forceps—an

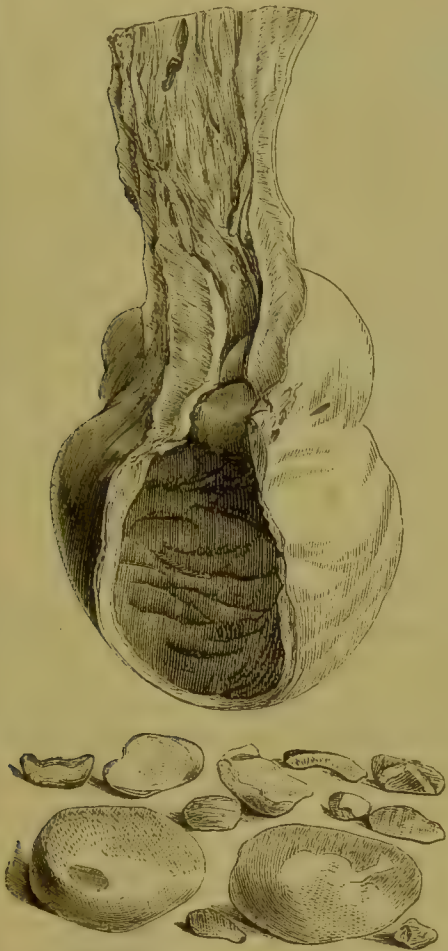


FIG. 393. Hypertrophy of the prostate gland, the middle lobe of which projects into the cavity of the bladder. The bladder is thickened and fasciculated, and its mucous membrane in a state of chronic inflammation. In the bladder was a stone, for which the patient, an elderly person, underwent the operation of lithotrity. The first operation passed off well, but at the second, which was seven days after the first, he had a severe rigor, from which he never rallied, and died ten days afterwards. Some fragments of calculus, seen at the bottom of the figure, were found in the bladder. The bladder had not been in the least injured by the operation; the kidneys were inflamed, large, and soft in texture, the pelvis of the right being covered with lymph, and containing a quantity of puriform fluid. On the external surface of this kidney were some small cysts containing pus.—St. George's Hospital Museum, Ser. xii. No. 35.

¹ Sir B. Brodie writes on this subject as follows:—‘There are, however, some very grave objections to this mode of proceeding. The withdrawing of the forceps, if much loaded with calculous matter, stretches the urethra beyond its natural diameter, and, in so doing, not only gives the patient much pain at the time, but renders him liable to rigors afterwards; secondly, in four instances in which I had adopted this practice the urethra was torn, and an infiltration of urine into the surrounding tissues, followed by urinary abscess, was the consequence. Two of these patients, in whom the mischief produced was deep in the perinæum, died, notwithstanding the abscesses having been freely opened as soon as they were detected.’—*Med.-Chir. Trans.* vol. xxxviii. p. 175. Sir H. Thompson speaks also to the same effect, and, indeed, since the introduction of the new method of lithotrity with evacuation, this plan of removing the fragments has been quite superseded.

operation requiring great care, delicacy, and slowness of manipulation. In a very few cases it is necessary to cut down in the middle line of the perinæum, when the surgeon will naturally consider whether he ought not to perform lithotomy at once, and in still rarer cases he may have to cut into the urethra in the penis.

5. The other complications are of minor importance. Some amount of retention not unusually follows a first sitting; orchitis, or epididymitis, is not uncommon from irritation of the urethra after the passage of fragments. Rigors and 'urethral fever' occur after this, as after all other operations on the urethra, but all these complications are to be treated on general principles.

Removal of
foreign
bodies.

The lithotrite, or lithotrite-scoop, or some analogous instrument, may often be employed with signal success in the removal of foreign bodies from the bladder. The most common case is where the fragment of a bougie has been broken into the bladder. If the surgeon is called in at once, he may pick up the foreign substance, and generally with ease, and should the piece be small it may come away without any trouble. If large it may be cut into pieces, which will pass of themselves. If treatment has been put off till a crust of phosphate has been deposited on the fragment, the case must be treated like any other case of stone.

More complicated foreign bodies generally require lithotomy, for, even if they could be caught and crushed, the fragments would be very dangerous to the urinary apparatus. Such cases are, as a general rule, very favourable for lithotomy, since there is no disease of the bladder or kidneys (see p. 245).

Prostatic
calculus.

Prostatic calculi have been spoken of incidentally on previous pages. They form small and often very numerous concretions, containing a good deal of animal matter, but consisting generally of phosphate and carbonate of lime,¹ sometimes almost entirely of the latter salt. These small concretions grow into the urethra, and often (I believe, usually) do not cause any special symptoms, but they may occasion pain and irritation in making water, and frequent erections and discharges of semen. In such cases they might be detected by careful exploration with the sound and finger. Calculi also may pass out of the bladder and lodge in the prostatic urethra, producing total or partial retention, and a calculus may grow from the bladder into the urethra (vesico-prostatic calculus), thus dilating the neck of the bladder and causing more or less incontinence. It often happens, however, that the urine can be retained, though not for any long period, although a calculus is projecting out of the bladder. In the female, also, I have known a stone grow out of the bladder into the urethra, and

Vesico-
prostatic
calculus.

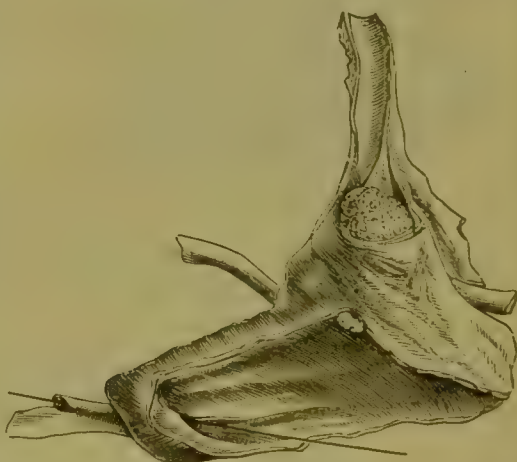


FIG. 394. A stone impacted in the neck of the bladder of a child, aged three. The stone seems to fill the prostatic urethra, but there is no history of complete retention of urine, though there had been great difficulty in passing water for about eight weeks. The child was brought to the hospital to be operated on, when symptoms of scarlet fever showed themselves, and he died in a few days. The bladder is small and thickened, the ureters are dilated. There is some malformation of the bladder, one side of it being much larger than the other, and from its apex projected a small elongated cyst (through which a bristle passes) which had every appearance of being a pervious portion of the urachus.—From a specimen in the Museum of St. George's Hospital, Ser. xii. No. 87.

¹ Their chemical composition, according to Dr. Wollaston, is phosphate of lime 84·5, carbonate of lime '5, animal matter 15·0.

produce incontinence of urine. Removal of calculi from the prostatic urethra by means of forceps is spoken of, and in the case of the small prostatic concretions it seems physically possible, and the attempt may be justifiable; but in all cases in which the stone is known or believed to have a vesical origin it should, if possible, be pushed back into the bladder with a lithotrite and crushed. If this is not possible, median lithotomy is indicated.

Stone in the urethra is a common cause of retention in boys. It is in all ordinary cases carried down from the bladder, though it is said that stone has formed in a pouch or diverticulum behind a stricture. The impaction of a calculus does not necessarily cause retention; in fact, a smooth and small calculus may produce very few symptoms, its impaction being due merely to its being turned with its longest diameter across the urethra, and when it happens to turn the other way it will come out. But large and sharp stones or fragments of stone give rise to much suffering, and unless removed early much mischief will follow from abscess, extravasation of urine, urinary fistula, &c. In some cases the obstacle to the passage of the stone depends on spasm of the urethra, and relaxation of this spasm by opium and the warm bath will prove successful. The patient should be directed to hold his urethra in front of the stone as long as possible while passing his water, in order to increase the force of the jet. If the stone be lodged far forwards patient and gentle attempts at extraction with the forceps will often succeed, especially if the stone can be manipulated so as to turn its long axis along the urethra. If such attempts are unsuccessful, and the stone is near the scrotum, it may be better to push it into the perinæum and cut down on it there; though I must say that I have not seen the harm which some surgeons describe as resulting from cutting into the urethra in the penis. If a catheter is passed into the bladder, tied in, and left open, the wound is pretty sure to heal. Stones impacted far back will not, probably, be extracted by the forceps. A free incision should be made on them, keeping the left thumb or forefinger pressed on the urethra behind, to prevent them from slipping into the bladder.

Stone
in the
urethra.

Stone in the female bladder, as I have pointed out above, is of very much less common occurrence, or rather, perhaps, it would be more correct to say that the surgeon is far less frequently called upon to treat the female for stone in the bladder than the male. Mr. Cadge states that in 1,125 operations for stone at the Norwich Hospital, there have been only 50 in the female—a proportion of about 1 to 20 in the male. This, no doubt, is due in the main to the fact that in consequence of the absence of the prostate gland and the shortness of the urethra and its dilatability, stones when formed are unconsciously passed, and therefore the cases do not come under our notice.¹ It is probable, however, that stone is not so commonly formed in the female as in the male, at all events in the adult, on account of the higher living and the greater amount of stimulant to which the latter is accustomed.

Stone in
the female.

The symptoms of stone in the female are nearly the same as in the male. If it is small and freely movable it produces the same symptoms of pain—irritability of the bladder, occasional stoppage in the flow of urine, blood and other morbid products in the secretion, and occasionally incontinence of urine. If the stone is large it frequently causes a prolapse of the posterior wall of the bladder into the vagina, and, becoming in a measure encysted, may produce

¹ There is in the museum of St. George's Hospital a stone $1\frac{1}{2}$ of an inch in its longest diameter, and $\frac{7}{8}$ of an inch in its shortest, which was passed by a woman whilst she was engaged in dressing her mistress's hair without any great amount of discomfort.

very little discomfort or very few symptoms. Under these circumstances the prolapsed bladder has been mistaken for a procidentia uteri. Calculi may be removed from the female bladder by lithectasy, by lithotomy, or by lithotriety. Lithectasy, or dilatation of the urethra, is the means which should be employed for the removal of all small stones, i.e. those of not more than an inch in diameter. The urethra should be dilated by Wiess's or other dilator, so as to admit of the introduction of a pair of lithotomy forceps and the extraction of the stone, which can be done with perfect safety and without any fear of incontinence following. When, however, the stone is larger than this, there is the probability of lacerating or unduly stretching the muscular coat of the urethra and thus setting up permanent incontinence of urine.

When the stone is of greater diameter than one inch, vaginal lithotomy would appear to be the best means of removing the stone, unless it is of such dimensions that there is not room to extract it through a vaginal incision without bruising the edges in such a way as would preclude their uniting by first intention—a matter of the first importance as regards the success of the operation. Under these circumstances the supra-pubic operation, as performed in the male, would have to be resorted to. Lithotriety is not so favourable an operation in the female as the male. As Sir H. Thompson says, 'the bladder soon becomes empty, and the manipulation and removal of large, sharp, and angular fragments in that condition is, I consider, a very hazardous proceeding, and one which probably involves more damage to the urethra, to say nothing of the bladder, than the removal of a good-sized stone entire.' Moreover, the principle of rapid evacuation after crushing cannot be employed in the same way as in the male. In a case in which I attempted this procedure I found that as fast as I forced the water into the bladder from the aspirator it escaped by the urethra and did not return into the bottle, so as to render the proceeding perfectly useless.

Vaginal lithotomy is an exceedingly simple proceeding. The patient having been placed in the lithotomy position, an ordinary curved male staff is introduced into the bladder and an incision made on to it through the anterior wall of the vagina, which has been dilated with a duckbill speculum. Through this opening a straight probe-pointed bistoury is introduced into the groove of the staff and the recto-vaginal septum incised to a sufficient extent to allow of the extraction of the stone. In making this incision care should be taken that it is free enough to allow of the stone being extracted without bruising or tearing the edges of the incision, and that it should be as far as possible from the urethra, so that the sphincter fibres of this canal should not be divided. After the stone is extracted the edges of the wound are to be at once united by silver sutures.

CHAPTER XXXVIII

DISEASES OF THE MALE ORGANS OF GENERATION.

AFFECTIONS OF THE TESTICLE AND ITS APPENDAGES.

THE congenital malformations of the testicle with which we are concerned in practice relate chiefly to irregularities in the descent of the gland. The cases reported of multiple testicles seem to be apocryphal, cysts in contact with the testicle having been mistaken for additional testicles. Congenital malformations.

There are cases in which the testicles are imperfectly developed, or even entirely absent, though the patient retains sexual feeling and power. Such persons, however, are probably sterile. Their possession of sexual power is accounted for by the fact that the vesiculæ seminales are present, being developed along with the vas deferens and epididymis from a different part of the embryo.

More common, however, and in a surgical point of view more important, is the retention of the testicle either in the abdomen or in the inguinal canal. Such retained testicles do not, in the opinion of most pathologists of the present day, secrete seminal fluid, i.e. fluid containing spermatozoa; so that the patient is sterile, if both testes be retained, though there is no reason why he should be in any respect deficient in sexual power.¹ Retained testis.

When a testicle has only descended into the inguinal canal, or when it descends very late into the scrotum,² a portion of bowel very often descends with it into the inguinal canal, and may easily become strangulated, especially as in these cases the internal ring is often very deep and narrow. And in other cases, though the testicle does not descend, the gut may come down into the scrotum, and, of course, may be strangulated there (see Fig. 326, p. 702). In all cases of hernia with retained testis, the first care of the surgeon is to replace the hernia if possible. If the testicle adheres to the hernia and the latter is reducible, so that the replacement of the bowel involves the reduction of the testis also into the abdomen, or into the groin, this is a matter of but little importance, provided a truss can be worn and the risks of hernia obviated. Even if the pressure of the truss were to cause atrophy of the testis, this is not an objection to the practice, since the testicle is probably useless from the beginning. If the hernia is reducible, without the testicle, a truss with a horse-shoe pad should be applied; the testicle lying in the concavity of the horse-shoe is not subjected to injury, while the pad serves to retain the rupture by making pressure on the upper part of the inguinal canal and the internal abdominal ring. But very often the hernia will be found irreducible, or the truss cannot be borne. In such cases a bag truss must be fitted. If an operation becomes necessary the surgeon will probably embrace the opportunity to remove the testicle, which is useless and in the way. With hernia.

¹ There is, however, much difference of opinion on this subject. The evidence on both sides is fully stated in Mr. Jacobson's article, 'Syst. of Surg.' 3rd ed. vol. iii. p. 465.

² Sir A. Cooper relates that he has seen the testicle descend as late as seventeen years of age, and Dr. Humphry speaks of a case as late as forty.

Such retained testicles have not unfrequently been known to be the seat of cancer,¹ and in other cases of hydrocele. Gonorrhœal orchitis is peculiarly painful when the testicle is retained in the canal.

There are also instances in which the testicle, instead of descending into the scrotum, has passed into the perinæum, or even through the saphenous opening into the groin. The knowledge of these rare anomalies will be useful to the surgeon in examining cases of supposed hernia or perinæal abscess. They have been operated on with success.²

In other cases the testicle is inverted in its descent, so that the cord lies in front of it, and the tunica vaginalis behind. This fact has its importance, as we shall see, in the practical surgery of hydrocele.

The persistence of the funicular canal is a fact of as much importance in hydrocele as in hernia.

The malformations of the penis derive their practical importance from the condition of the urethra and bladder, and have been spoken of on pp. 771, 785.

The *diseases* of the male organs may be divided into those of the testicles, scrotum, and penis. The vesiculæ seminales might perhaps be added, but their affections are not well understood, and the diseases of the prostate are treated along with those of the urinary organs, with which they have a nearer connection than with those of the generative system.

Hydrocele.

The diseases of the testicles will be first considered. Of these perhaps the commonest is *hydrocele*, a collection of fluid in the tunica vaginalis, the result of over-secretion or passive dropsy.

No symptoms attend the formation of a hydrocele, so that any swelling in the testicle which forms painlessly and gives no inconvenience except that occasioned by its weight is suspected to be a hydrocele till proved otherwise.

The forms of hydrocele are various, corresponding to the condition of the tunica vaginalis and its funicular process.

In the ordinary condition the tunica vaginalis is entirely separated from the peritoneal cavity by the whole extent of the scrotum and inguinal canal. It only covers the front and sides of the testis, extending somewhat under the epididymis and around its head, but is reflected forwards from the sides of that body so as to leave its posterior part free. Consequently, when this cavity is distended with fluid, which constitutes the common hydrocele, the swelling lies in front of the testicle and above it (Fig. 330, p. 703). The testicle may be sometimes felt at the back of the tumour; the scrotal cord is perfectly free. The collection of fluid is often too tightly bound down to permit of the feeling of fluctuation; it is commonly transparent, though often not so, in consequence of the thickness of the sac. It is pyriform, and if the patient is intelligent he will have noticed that it has begun from the bottom of the scrotum and extended upwards. When punctured a greenish or yellowish serum is drawn off, which is rich in albumen, so that it coagulates on the application of heat or nitric acid like the serum of the blood. The causes of hydrocele are not well understood. It is a common complication of chronic inflammation of the testicle (hydrosarcocele), and a certain amount of hydrocele also usually accompanies acute orchitis. Its inflammatory origin is testified also by the fact that it is not infrequently referred

¹ Dr. G. Johnson, 'Med.-Chir. Trans.' vol. xlii. Mr. Hodgson, 'St. George's Hospital Reports,' vol. ii.

² See Annandale in 'Brit. Med. Journ.' Jan. 1879.

to an injury. Yet in most cases of pure hydrocele nothing of the kind can be traced. It is spoken of vaguely as a 'local dropsy,' but certainly has no connection or affinity with general dropsy.

The diagnosis of this form of hydrocele from hernia is usually easy—in fact obvious—for, as the cord is free between the tumour and the external inguinal ring, no confusion between hernia and hydrocele, or any other uncomplicated tumour of the testis or its coverings, is possible. But hydrocele, or any other scrotal tumour, may be combined with hernia, as shown in the diagram above referred to (Fig. 330); and then in the part caused by the hydrocele transparency will be found without impulse or reducibility, and in the hernia opacity with impulse, and probably with reducibility. If the hernia is strangulated, the characteristic symptoms of that condition will demand the reduction of the bowel either by taxis or operation, and after this has been accomplished the nature of the tumour will become plain. But old hydroceles with a thick non-transparent sac are not easily distinguished from solid tumours of the testicle; on the contrary, they are sometimes almost indistinguishable from them. I once assisted a surgeon of great experience in an operation on a case, which I had not seen before, where he proposed to remove the testicle on account of supposed malignant disease, which on incision turned out to be a simple hydrocele; and I was once consulted in a similar case, where, remembering this, I avoided the same error only by a puncture with a trocar after the patient had been prepared for the operation. So also with hæmatocele, as to which the reader is referred to the section on that disease.

The treatment of simple hydrocele may be palliative or radical. The latter cannot be devoid of pain, and involves some, though a very trifling, risk. Consequently, many persons prefer to go on with the palliative treat-

ment, or, in plainer terms, to have the hydrocele tapped from time to time instead of attempting its cure. Tapping a hydrocele is a very simple proceeding, though it is sometimes mismanaged. The back part of the scrotum is to be drawn backwards so as to make its front surface tense. A part of the skin is to be chosen free from large veins, and a small trocar is to be plunged in boldly, inclining upwards, in order to avoid the testicle. This gives, it may be said, no pain, and after the swelling has been emptied the cannula is withdrawn and a bit of strapping applied. When the fluid has re-collected to such an extent as to cause pain and dragging on the loins, this little operation may be repeated, or the

Diagnosis.

Tapping.



FIG. 395. Tapping a hydrocele. After Liston. The probable position of the testis is indicated by a dotted line.

radical cure may be undertaken. When the fluid has all been withdrawn, the condition of the testis must be carefully examined, for before the emptying of the sac it is difficult, if not impossible, to be sure that the gland itself is healthy, and if it be not so it will be vain to try and cure the disease by any measures directed solely to the tunica vaginalis.

Cases in which the testicle lies in front.

In this, the common, method of tapping a hydrocele the testicle is supposed to be behind, as it is in ninety-nine cases out of a hundred. But there are rare instances in which the position is reversed; and the gland lies in front of the fluid. I once saw such a case in which a trocar had been twice thrust into the testicle in attempts to empty the hydrocele. This reversal of the position depends on one of two causes: (1) The hydrocele may have been tapped, and in this operation the front surface of the testicle may have been punctured. In consequence of this the testicle contracts an adhesion to the front of the hydrocelic cavity, and when the fluid re-collects the testicle lies at the front of the tumour and the fluid laps round each side of it, so as to appear behind it, though this is hardly the case in strictness of speech; or (2) the hydrocele may really lie entirely behind the testicle as a consequence of congenital peculiarity, for it seems that sometimes the testis gets twisted, as it were, in its descent into the scrotum, so that the epididymis and cord are in front of the gland and the tunica vaginalis behind it; and if in a case like this hydrocele should occur it must, of course, be altogether behind the testicle. Such a position could not be detected if the tunica vaginalis were thick and opaque; but in ordinary cases careful exploration by transmitted light will distinguish the position of the testicle, or the elasticity of the part will convince the surgeon where fluid is to be found; or palpation may elicit sensations in the patient which will enable him to point out the situation of the gland. Fortunately, if in an obscure case the testicle is punctured, no serious mischief usually follows; the error, however, is a discreditable one when, as commonly happens, it is the result of pure negligence.

Radical cure.

Incision of the sac.

The radical cure of hydrocele used to be effected by laying the sac freely open, and this is sometimes still necessary in cases of obstinate recurrence. It is also, I think, often advisable in cases where the sac is unusually thick, or where the patient is very sensitive to pain, or where, from any cause, he is especially anxious to avoid all liability to recurrence. It is usually quite painless, and the temperature and pulse usually remain normal. Still it cannot be denied that it does involve some risk, and it certainly requires a few days' confinement to bed. The operation is a very simple one. The tunica vaginalis is exposed by a free incision, opened to the extent of about two inches, and its margins stitched to the skin with a few sutures of carbolised gut. The cavity is then washed out, and the operation and after-treatment are, of course, conducted with the strictest antiseptic precautions. A still more radical measure consists in dissecting out the parietal layer of the tunica vaginalis. This renders recurrence absolutely impossible. The membrane can be removed without difficulty by snipping through the loose connective tissue with blunt scissors, and should be taken away close up to the epididymis and testicle. The operation is only required in some rare cases when the sac is very thick.¹

Port-wine injection.

Commonly, however, the injection of the sac suffices. The old plan was after withdrawing the fluid to fill the sac with port-wine and water in equal parts (the French use alcohol and water in various proportions) and keep it in the sac till the patient felt a good deal of pain and began to feel sick and faint. Then the cannula was opened and as much of the fluid as would run out was allowed to escape. The modern plan (introduced by the late Sir R. Martin) is less troublesome to the patient, and is usually effective. Two

¹ See a paper by Dr. W. T. Bull, 'New York Medical Journal,' March 13, 1886, p. 294.

drachms of an equal mixture of Tinct. Iodi and water are passed into the emptied sac and left there. The effect of the injection of a hydrocele is always a smart attack of inflammation, the sac usually filling to the same size as before, and with a good deal of redness of the skin and pain. But as this subsides the part resumes and retains its natural size, at least if the operation is successful. As the injection of iodine is painful and not absolutely certain to cure the disease, other methods have been employed. The one which seems to me most promising is that introduced by Dr. Levis of Philadelphia.¹ The deliquesced crystals of the acid are used, i.e. the pure acid with about 5–10 per cent. of water or glycerine, and from half a drachm to a drachm (according to the size of the sac) of this is passed into the emptied sac by means of a graduated syringe with a nozzle long enough to project through the cannula into the sac. Very little pain or reaction is produced at first, but after about twenty-four hours the usual inflammation follows, though in the cases I have operated on (less than ten in number as yet) not to the usual extent. It also seems to subside more rapidly. Dr. Levis says that he has used this injection in private and hospital practice for nine years, and met with no case of carbolic poisoning, nor any in which it has failed to effect a radical cure. In three of these the iodine injection had failed.

Iodine injection.

After the injection of hydrocele the tunica vaginalis is sometimes obliterated by adhesions; but this is not necessary for cure, and is believed not to be the usual result; though precise information on this head can hardly be obtained, since such operations never prove fatal and have been forgotten before the patient's death even if his body is examined. Should the hydrocele recur after the iodine or other injection, as it sometimes does, the best plan is to inject it with port-wine, or with sulphate of zinc lotion (gr. iv. to ʒi.) used in the same way as the port-wine injection, and, if it still recurs, to lay it open; but in these cases very careful examination of the testicle should be made, to ascertain whether it really is a case of simple hydrocele.

Setons are now, I believe, entirely disused.

Setons.

The other forms of hydrocele depend on the condition of the tunica vaginalis and its funicular process in respect of their obliteration.

When the whole funicular process remains open and the communication is not large enough to admit a piece of bowel, the serous secretion of the peritoneum may distend the scrotal pouch and form a *congenital hydrocele*.² Congenital is distinguished from common hydrocele by its shape and extent, and by the fact that the fluid can be returned, though often only slowly and with much difficulty, into the belly, and from hernia by its transparency³

Congenital hydrocele.

¹ 'The Treatment of Hydrocele, and Serous Cysts in general, by the Injection of Carbolic Acid.'—'Transactions of the Med. Soc. of the State of Pennsylvania,' 1881.

² It must be recollected that this is not a necessary consequence of the persistence of the communication if it be very small.

³ It must be remembered that a hernia cannot under ordinary circumstances be transparent, since both the viscera and the omentum, which form its contents, are themselves perfectly opaque. In very rare cases the hernial sac is dropsical or distended with clear serum—'hydrocele of the hernial sac.' This usually occurs after the obliteration of the neck of the sac by the pressure of the truss, or its partial obstruction by adherent omentum. The difficulty of diagnosis is great, as may be seen by reference to Mr. Curling's chapter on this subject in his treatise on 'Diseases of the Testis.' The feeling of impulse at the neck of the sac, the history of the case, and the different relations of the testis to the tumour from those which are met with in hydrocele, are the points to be chiefly attended to.

(which, I believe, is almost if not quite always present), and by the different sensation which the surgeon feels in reducing it.

The treatment of congenital hydrocele consists in evacuating the fluid with a fine trocar and endeavouring to procure the obliteration of the patent canal by making continuous pressure on it near the external inguinal ring by means of a truss, which should be worn night and day if possible; and as fast as the fluid re-accumulates the puncture should be repeated. Most cases, I believe, ultimately recover. If not, the communication will probably enlarge and hernia will ensue. In France it seems common to treat congenital hydrocele by injection with alcohol, pressure being maintained on the ring while the sac is being injected; and Mr. Curling speaks favourably of iodine injection, while Mr. Jacobson proposes to lay open the sac (under antiseptics) and allow it to granulate up, or even to remove it, as in the radical cure of hernia recommended by Mr. M. Banks (p. 691),¹ but the gravity of the disease seems hardly sufficient in most cases to warrant measures which cannot be free from considerable risk.

Infantile
hydrocele.

Infantile hydrocele is very common. The tunica vaginalis and its funicular prolongation are distended with clear serum, but the scrotal portion of the funicular portion is separated from the peritoneal cavity by a septum at the external ring (Fig. 328, p. 703), so that the fluid will not pass into the peritoneal cavity whatever force be used and however the canal may be straightened out; but very careful examination in this respect is necessary before the hydrocele can be confidently said not to communicate with the peritoneum, so easy is it to close a small communication by any folding over of the parts; and then what is really a congenital may easily be mistaken for an infantile hydrocele. Infantile hydrocele generally disappears spontaneously or after the application of a stimulating lotion of arnica or hydrochlorate of ammonia or tincture of iodine to the skin; or it may be punctured subcutaneously, or otherwise. There is no objection to injecting such a hydrocele, but it is rarely necessary.

Hydrocele
of the cord.

Hydrocele of the cord proceeds from the effusion of serum into an unobliterated portion of the funicular process (Fig. 331, p. 703), or perhaps from the growth of an independent cyst in the cellular tissue of the cord. It is commonly met with in children or boys about puberty, and causes a small round tense swelling in the course of the cord separate from the testicle, and therefore easy to distinguish from common hydrocele or any tumour of the testis, and if also distinctly separable from the external inguinal ring, equally easy to distinguish from hernia, and therefore unmistakable. But as the cyst may extend up to or beyond the ring, there is in such a case a very great resemblance to hernia; so that I have seen a case of the kind treated for hernia at one of our truss societies. Careful examination, however, will show that the supposed hernia cannot be made to return into the belly, though there is no strangulation; that the impulse it receives is much less than a hernia would have; and that it forms a small rounded swelling instead of a long tubular one; and if the child be taken into a dark room, and the candle be dexterously arranged, transparency can usually be detected in spite of the smallness of the cyst and fatness of the part. There is then no further doubt. But if with a cyst situated so high up there should be any symptoms of strangulation, it would be right to cut down on the tumour and open it; and, in fact, whenever there is any considerable doubt,

¹ A case in which this operation was successfully performed is reported by Mr. Southam in the 'Brit. Med. Journ.' Jan. 26, 1884.

the same course may be justifiable, rather than expose the child to the annoyance of wearing a truss unnecessarily.

These cysts are easily curable by injection with a small quantity of tincture of iodine, say ʒj. of a mixture of equal parts of the tincture and water, or ʒss. of the pure tincture. I have also cured them by a silver seton, but with more inflammation and distress, and more readily and surely by cutting the cyst open and leaving it to fill up.

Besides these encysted hydroceles of the cord, which are common enough, diffused hydrocele of the cord is spoken of, forming a long, sausage-shaped tumour around the whole cord; but if it occurs it is exceedingly rare. Dr. Humphry says that no such case is known to have presented itself in modern times, and refers to the works of Pott and Scarpa for all that is known about it. Their accounts will be found in a condensed form in Mr. Curling's work.

Encysted hydrocele of the testicle consists in the formation of a cyst in contact with the testicle itself and not with the cord. The usual position of these cysts is in the head of the epididymis, and they generally contain spermatic fluid. But they are found in other situations, as between the tunica vaginalis and albuginea; and they may contain, not the milky fluid which results from the admixture of semen, and which presents spermatozoa under the microscope, but the same nearly watery secretion as is contained in the cysts of the cord. Their diagnosis from common hydrocele is formed either from their position—for they do not envelope the testicle like common hydrocele, but lie above, behind, or at the side of it like a double testis—or from the milky or watery nature of their contents, which contrasts forcibly with the albuminous serum of ordinary hydrocele.¹ The way in which semen gets into these cysts is not, perhaps, fully understood; but there is no question that in many cases a distinct communication has been seen between the cyst and the tubes of the epididymis; and if we allow that in the cases where no opening has been found there was really no opening, still it might have been present at one time, and then have become obliterated. In the watery cysts, however, no such communication can at any time have existed. It seems, on the whole, most probable that these cysts originate in different ways—either as outgrowths (or buds as it were) from the tubes of the epididymis, the opening of which may or may not become obliterated, or as independent formations in the cellular tissue of the cord, which afterwards may or may not form a communication with its seminiferous tubes. It has also been suggested, but on pure hypothesis, that they may be overdeveloped remains of the Wolffian body which have not become connected with the testicle. A much more probable hypothesis is that put forward in a very interesting paper by Mr. S. Osborn in the St. Thomas's Hospital Reports for the year 1875. He traces the development of these cysts to the 'hydatid of Morgagni,' a small cystic body which is always found between the testis and the globus major, and is the remnant of the Müllerian duct. The paper and the preparations depicted in it are well worth studying.²

Encysted
hydrocele
of the
testis.

The treatment is the same as that of common hydrocele; but as the tumour is usually smaller and fills more slowly than in hydrocele of the tunica vaginalis, there is less motive for undertaking the radical cure.

¹ A few cases are, however, on record in which milky fluid has been found in the sac of a common hydrocele. Some of these were connected with the presence of the *Filaria hominis*. See Davis, 'Brit. Med. Journ.' June 20, 1885.

² See also Mr. Jacobson's Essay, p. 496.

Loose
bodies in
the tunica
vaginalis.

The cavity of a hydrocele sometimes contains a loose body. This, as Mr. Osborn points out, may be formed by the hydatid of Morgagni becoming degenerated into a solid tumour, much as an enlarged bursa does, and then dropping off its peduncle; and Dr. Humphry has pointed out a similar process for the development of these movable bodies, and has given an interesting example of the recognition and removal of one of them during life by incision.¹ In a case by Sir B. Brodie a patient who had one of these loose bodies used to complain of intolerable pain after the operation for tapping; and they often set up a certain amount of irritation, and no doubt either produce or keep up the effusion of fluid into the tunica vaginalis. They should therefore always be removed when they can be recognised. I have no doubt that they may arise from various causes, just as loose cartilages do; and their structure bears much analogy to that of the loose bodies in the joints. In Dr. Humphry's case the loose body, which was the size of a bean, was composed of 'compact fibrous layers encircling an earthy nucleus.'

Hæmato-
cele.

Hæmato-
cele of the
cord.

Common hæmatocele is a collection of blood in the cavity of the tunica vaginalis. It usually follows on some sprain or injury whereby a vessel is ruptured on the internal surface of the membrane, and this is often the case when hydrocele is already present. The same thing happens sometimes in hydrocele of the cord and in encysted hydrocele, which by some blow or injury becomes filled with blood, or converted into hæmatocele. In the cord, however, this is so uncommon that I think it not worth while to spend more space upon it. In the tunica vaginalis it appears common enough. Hæmatocele may be produced by a blow or a strain in the previously sound condition of the organ, giving rise to hæmorrhage into the cavity of the tunica vaginalis, or by similar injuries, or the puncture of the trocar, in cases of hydrocele, and perhaps by spontaneous rupture of or exhalation from some vessel in the lining of the sac.

The tumour has generally a somewhat more rounded shape than a hydrocele, is heavier, less homogeneous, part of it being knobby and semi-solid, is perfectly devoid of transparency, and often accompanied by a dark colour of the scrotum, due to blood sugillating into the subcutaneous tissue.

Diagnosis.

The diagnosis is anything but easy. It is hardly too much to say (at least I may say it for myself) that the surgeon can never be sure of the diagnosis of a hæmatocele till he has punctured it. It may be a solid tumour of the testis (perhaps inflammatory, but more probably malignant), or a hydrocele with a thick sac. The diagnostic signs are as follows:—Chronic orchitis is generally accompanied by a more definite history of its causation than hæmatocele, i.e. it follows directly on acute orchitis or as the result of a blow, the tumour having been always solid, and increasing gradually; or after syphilis, with some other distinct syphilitic symptoms. Cancer of the testicle advances more rapidly, has a greater tendency to spread up the cord, and is accompanied with more pain. (I do not speak of advanced cases of cancer complicated with enlarged lumbar glands, where there is no difficulty in diagnosis.) Hydrocele is wanting usually in the history of injury and of sudden increase to a certain size, but there is a gradual and progressive enlargement. But the reader will see at once that all these signs are dubious; and an experience of the complexities of practice and the uncertain-

¹ 'Syst. of Surg.' 3rd ed. vol. iii. p. 514.

ties of patients' histories will enable him easily to judge how dubious they are. It is, however, more especially the early stage of cancer which bears the strongest resemblance to hæmatocele.

Notwithstanding, however, the difficulty experienced in diagnosing hæmatocele, there are many cases in which the symptoms and history point strongly to the correct conclusion; and in any case where there is a real necessity for operative interference a preliminary incision will settle the matter, and can do no harm.

Sometimes hæmatocele, if neglected, grows to an enormous size, producing atrophy of the testis; at other times the blood degenerates into a turbid, grumous mass, very like the contents of the small intestine.¹

In very old cases of hæmatocele probably the safest and best course is to remove the whole tumour with the testicle; but as a general rule it will be sufficient to lay open the tumour by a free crucial incision, turn out all the clots, tie any vessels in the thickened tunic which bleed freely enough to require it, and allow the cavity to granulate up.² At the same time it should be remembered that the operation is a severe one, and in old or unhealthy persons it should not be lightly undertaken. I have seen death follow it. In cases of recent hæmatocele absorption of the blood may be procured by rest, evaporating lotions, ice, &c., and if the swelling does not subside in a satisfactory manner tapping may be resorted to. If the coverings are thin and the blood entirely fluid, iodine injection may be successfully employed.

Treatment.

M. Reverdin³ has recorded several cases from his own and other experience, in which a hydrocele has given way either spontaneously or from injury, and a blood-tumour has formed in the tissue around the ruptured tunica vaginalis, the blood mingling also in greater or less proportion with the fluid of the hydrocele. The source of the hæmorrhage he believes to be the large veins which lie between the serous and fibrous layers of the tunica vaginalis. The blood is limited externally by a fibrous membrane, which, according to this author, is the fibrous layer of the vaginal tunic. On incising the tunica vaginalis (which seems the most appropriate treatment) the rent will be seen. The diagnosis is easy from the previous existence of hydrocele, the great and sudden increase of the swelling (usually from injury, but sometimes without any known cause), and the appearance of ecchymosis in the scrotum. M. Reverdin believes that in cases of spontaneous rupture the hydrocele has been previously increasing rapidly under the influence of some irritating cause, which has also produced atrophy or degeneration of the tunica vaginalis. The original memoir will well repay perusal, but the cases seem to be too rare to justify a further expenditure of space.

Hydro-hæmatocele, with rupture of the tunica vaginalis.

Orchitis, or inflammation of the testicle, is divided into acute and chronic. If the word orchitis were construed so literally as to restrict it to inflammation of the body of the gland, excluding the epididymis, we might say that acute orchitis is almost always caused by a blow, by gout, or by metastasis in mumps, since the familiar acute inflammation of gonorrhœa is properly epididymitis, but this is in ordinary language included in the term orchitis. The inflammation also which follows from impaction of calculus, after litho-

Acute orchitis.

¹ I once saw a surgeon, on opening a hæmatocele of this kind, start back, fancying for a moment that he had laid open a hernia.

² Some singular cases are recorded by Mr. Curling in which the testicle was inverted and lay in front of the hæmatocele, so that the surgeon, having in his incision seriously injured the testicle or vas deferens, was obliged to perform castration.

³ 'Annales des Maladies des Organes Génito-urinaires,' June and July 1883.

trity, catheterisation, &c., is originally, like gonorrhœal orchitis, situated in the epididymis.

Gonorrhœal orchitis, or epididymitis.

Gonorrhœal orchitis usually occurs somewhat late in the disease, and often after the discharge has more or less subsided; whether it occurs from inflammation spreading up the vas deferens to the epididymis, or from some nervous 'sympathy,' the nature of which is obscure, is as yet undecided.

It commences when in its severest form with rigors, sickening pain in the back and loins as well as in the testicle, heat and redness of the scrotum, swelling and tenderness of the epididymis, and distension of the tunica vaginalis with serum and lymph. The body of the testicle becomes more or less affected as the disease progresses. The inflammation appears to be at first seated in the intertubular connective tissue, afterwards the tubuli themselves become loaded with lymph.

On the subsidence of the disease it seems not very uncommon for the tubuli seminiferi, and probably also the large excretory tubes of the vas deferens, to be choked up by this lymph, so that the testicle is left useless; and if both testes have been affected the patient is sterile,¹ though the testicles may not be wasted, nor the patient deficient in sexual vigour.

Treatment.

The treatment of gonorrhœal orchitis is now far less severe than it used to be. Very many cases are found to get perfectly well with no more active treatment than rest in bed, with the testicle wrapped up in a warm poultice.² In other cases the treatment by the application of ice is most successful, and is recommended on the high authority of Mr. Curling. When there is much pain opium should be freely given. Leeches sometimes also relieve pain if followed by warm bathing. Free purging is very desirable, and if much inflammatory fever be present antimony in moderate doses is indicated. In the initial stages, when confined to the epididymis, the disease may sometimes be arrested by carefully strapping the part, according to Dr. Humphry. When the pain is gone, but swelling lingers, strapping is most beneficial if the pressure be well and equally applied, but this is an art which all people do not possess.³ The application, also, of mercurial ointment below the strapping, or rubbing in a small quantity of mercury, often removes the swelling.

Puncture of the testis in orchitis.

I never saw any need for puncturing the testicle, and I believe the treatment to be altogether unsurgical and unnecessary—unsurgical because it exposes the patient to some danger of permanent injury to or atrophy of the testis, without any corresponding risk in the disease itself, and unnecessary because relief can be obtained without any such violent proceeding. Mr. H. Smith is the chief advocate for the puncture, which he at first spoke of as a free incision into the tunica albuginea, though this description was afterwards modified into a lancet puncture. I have no doubt that a free incision would cause atrophy of the testis in a large proportion of cases. The lancet puncture is, I dare say, usually harmless (and the more so because I believe it often does not reach the testicle at all), but it must also be quite inefficient. The pain in orchitis is commonly (though not with indubitable accuracy) referred

¹ See Jacobson, *op. cit.* p. 527.

² Dr. Humphry says that without treatment, or even rest, most cases would end in resolution.

³ To strap a testicle, separate it from its fellow and pull the skin tight, put the first strap round the scrotal cord, the next perpendicular to the first between the testicles, the third half overlapping the first, and the fourth the second, and so on till the whole gland is equably covered. The skin ought not to be pinched anywhere between the straps, nor should the pressure be painful anywhere. The straps should be about half an inch wide.

to the tension of the tunica albuginea. If we accept this view, how can a small puncture relieve this tension? The tunica albuginea is not a hollow bag which if pricked in one part will collapse in its whole circumference. In order to give any effectual relief to its tension it must be freely incised, and then the inflamed and swollen substance of the testis will only too probably protrude through the incision, and the patient will have every reason to regret the activity of the treatment. However, in reality the body of the testis is rarely so much affected as the epididymis; and how can puncture in the body of the testis relieve inflammatory swelling of the globus major? If it be replied that as a matter of fact the puncture is often followed by diminution of the pain, I am quite ready to admit it. The reason is, no doubt, because the tunica vaginalis (which is almost always acutely inflamed) is punctured, and this, being a hollow bag, can be at once emptied by even a small puncture, with temporary relief to the tension. But such relief is only temporary—it does not in any way tend to cure the epididymitis—and so far as it enables the patient to get about it prevents him from obtaining the great requisite of treatment—rest. Orchitis in almost every case is caused, and in every case aggravated, by exertion or excess of some kind, and the first dictate of common sense as well as of sound surgery is to put the man to bed and keep him quiet. I have often watched the relief which follows on this simple proceeding in cases where the pain has been very severe. Relief thus obtained is nearly as quick and far more lasting than that which follows on puncture, and it tends to cure the disease itself, while exertion and every kind of excitement tend to aggravate and perpetuate it. For which reasons I altogether deprecate the practice of puncturing the testicle itself, and I believe the puncture of the tunica vaginalis to be in almost all cases superfluous and unadvisable, though it has been advocated by some good surgeons,¹ and in the somewhat rare cases in which suppuration is imminent, or has already commenced, is urgently indicated.

The orchitis which follows on injuries, mumps or other causes, must be treated on the same general principles, and Dr. Humphry gives a useful caution to examine the urethra in cases of recurrent orchitis, since the recurrence often depends on the presence of stricture, and can only be obviated by its cure. The acute orchitis of mumps is remarkable as being an affection of the body of the gland, and as being liable, occasionally, to be followed by total wasting of the organ; but as far as recorded cases go this unfortunate event does not seem ever to occur on both sides. Acute (or subacute) orchitis also happens occasionally in gout and rheumatism.

Chronic orchitis is an occasional result of the acute disease, and is sometimes called '*simple* sarcocele' to distinguish it from the orchitis dependent upon the tubercular or syphilitic taint to which the corresponding adjective is added. It is essentially a chronic inflammation of the organ, not depending upon syphilis or deposit of tubercle. It consists in the effusion of inflammatory products, which undergo an imperfect development into connective tissue, expanding the bulk of the testicle and compressing the vessels and the tubuli seminiferi. Occasionally it may go on to suppuration and the formation of abscess, which may result in a protrusion of the tubuli

Chronic
orchitis

¹ On this subject I may refer the reader to a correspondence between Mr. H. Smith and myself in the '*Lancet*' for January 1876; to an article by Mr. Hutchinson in the '*Med. Times and Gazette*,' April 22, 1871, in which he seems to speak with approval of the puncture of the tunica vaginalis; to a letter by Mr. Macnamara in the same sense in the '*Lancet*' for 1876; and to Mr. Curling's standard work.

seminiferi, mixed with inflammatory products (hernia testis or benign fungus).

Usually one testicle only is affected, and the corresponding cord is generally somewhat thickened. The scrotum is not involved unless suppuration occurs.

The symptoms consist in a gradual enlargement, remaining after an acute attack, or occurring as the result of a blow or injury. Both the body and the epididymis are generally involved, though the chief enlargement is in the body of the organ, which is smooth and hard, tender on pressure, and a constant dragging pain is complained of. The cord is generally thickened and infiltrated, and there may be some amount of fluid effusion in the tunica vaginalis. If suppuration is taking place, the skin of the scrotum becomes red, shining, and thinned, and adhesions take place between it and the testicle, and eventually the abscess bursts, or is opened, and a fistulous channel left. Through this the tubuli seminiferi may protrude, forming a fungous mass, which increases in size, and is accompanied by a diminution in size of the testicle itself.

This simple form of orchitis usually terminates in recovery if treated early, but occasionally atrophy of the testicle results and the organ becomes useless.

The treatment in these cases consists in promoting absorption of the effused inflammatory products by carefully applied pressure. This is to be done by strapping the testicle with soap-plaister, diachylon, or emplastrum hydrargyri. This will generally succeed in diminishing the swelling and restoring the organ to its healthy normal condition. Should it not do so, it may be due to the pressure of fluid in the tunica vaginalis, which must be withdrawn and the strapping at once re-applied. In cases where the enlargement is so great as to prove a source of annoyance and discomfort to the patient, and in which the testicle does not improve under treatment, it must be removed. Hernia may be treated by the application of the red oxide of mercury and pressure, which will generally succeed in repressing the fungus if it be small. If large it may be necessary to remove the protruding part before applying the mercury and strapping; and in cases when it includes the greater part of the organ, it is better to remove the whole gland, since it is practically useless and would prove a constant source of annoyance and discomfort to the patient from protracted and long-continued suppuration.

Syphilitic
orchitis.

Chronic orchitis, the result of syphilis, or 'syphilitic sarcocele,' presents itself in two different forms: either as an inflammatory condition, in which there is a diffuse thickening of the connective tissue of the testicle, or as a gummatous affection, in which 'gummy' deposits are found infiltrating the organ.

It is usually regarded as a late secondary or tertiary condition, and may occur as the result of inherited syphilis, as well as in the acquired form of the disease. The inflammatory form consists in an overgrowth of the connective tissue of the organ, which is the result, in the first instance, of a round-celled infiltration of the parenchymatous tissue, which becomes converted into a dense fibroid material which presses upon and replaces the normal gland structure. If a section of the organ in which the disease is considerably advanced be examined, the tunica albuginea will be found to be much thickened, and radiating from it are dense white processes, which have encroached upon and obscured the gland structure. In places the normal tissue of the testicle will be found to have entirely disappeared and

to be completely replaced by dense fibroid tissue ; whilst in other parts some remains of the gland structure will be visible, but atrophied and encroached upon in such a way as to be scarcely recognisable. In the gummatous form, in addition to the fibroid induration above described, there is found on section masses of typical gummy deposit of an opaque yellowish colour and leathery consistence. These vary in size and are tolerably circumscribed, but are usually surrounded by a zone of thickened tissue, which presents microscopically abundant round-celled infiltration. Under the microscope these deposits present the characteristic appearance of gummy tumours (as described on page 411).

The symptoms of syphilitic orchitis come on very insidiously, and as a rule progress slowly and painlessly. Often the outset of the disease is not perceived by the patient, nor is he aware of its existence until he accidentally discovers a hard nodule in, or enlargement of, his testicle. The disease usually begins in one organ, and then affects the other ; it is rare for the two to be attacked simultaneously. It involves the body of the gland in the first instance, and for the most part the epididymis escapes altogether, though in some instances it may be secondarily affected. In the early stage the whole or a part of the body of the testicle becomes enlarged, the enlargement being somewhat nodular, and feeling hard and stony, sometimes almost like cartilage. The cord and epididymis are usually unaffected, but the latter is sometimes obscured altogether by the swelling of the body of the organ. There is usually no pain or tenderness beyond a dragging sensation which is sometimes complained of, and testicular sensation is early lost. There is little tendency to suppuration, even the deposits in the gummatous form rarely breaking down and forming pus. There is almost always in these cases more or less fluid in the tunica vaginalis, constituting the 'hydro-sarcocele' of the older authors.

The treatment must depend in a great measure upon whether the patient has been subjected to a thorough mercurial course, and the length of time the disease has appeared after the primary affection. If it is of comparatively recent date, and it is apparent or probable that the patient has not had a sufficiently thorough course of mercury, inunction into the scrotum will generally have a very beneficial result. Blue ointment or the oleate of mercury ointment is to be spread on flannel, and the testicle wrapped in this and supported in a suspensory bandage. A fresh quantity of the ointment (about a drachm) is to be applied daily, and the constant friction will generally succeed in diminishing the swelling. If there is any large collection of fluid in the tunica vaginalis, it is advisable to remove this before applying the ointment, but no attempt should be made by the injection of iodine to cure the hydrocele.

If, on the other hand, the patient has had a prolonged mercurial course, and the disease has come on at a late period of the syphilitic history, and the patient presents a marked cachexia, probably mercury either locally or generally is not desirable, at all events in the first instance. Iodide of potassium, with tonics, change to the sea-side, careful and nutritious dieting, and other means to improve the patient's condition should first be resorted to ; but even in these cases, when the patient's health is somewhat restored, the local application of mercury will generally be found to expedite the cure.

Tubercular disease of the testicle consists in the deposit of tubercle in the glandular substance, generally of the epididymis, the body of the gland

Tubercular
orchitis.

becoming frequently secondarily involved, and often early in the course of the disease. The disease may commence at any period of life, but is most frequently found in early manhood, and in those of a feeble constitution or presenting the aspect of a scrofulous diathesis. There may not be, and frequently is not, any evidence of the deposit of tubercle elsewhere in the body. The disease is often set up in the first instance, or at all events arises, as a sequence to an attack of gonorrhœal epididymitis, or else as the result of a blow or squeeze.

On making a section of a testicle affected with tubercular disease in an early stage the epididymis will be found to be studded with small, hard, semi-transparent nodules (grey granulation). These soon undergo degeneration and become opaque and fused together so as to form a cheesy mass, which is often softened and broken down in the centre. Some difference of opinion exists as to the exact starting-point of this tubercular condition, but there seems to be a great probability that it commences in the lymphoid tissue which surrounds the tubes. The disease generally commences in one testicle, but in a considerable number of cases the other organ becomes secondarily affected, so that when both are affected, it is usual to find it much further advanced on the one side than the other.

The symptoms of tubercular disease of the testicle are in the first instance slight. The patient may perhaps complain of slight tenderness in the part, and on examination the epididymis will be found to be enlarged, and contain an indolent lump. Later on the whole of the epididymis will be found to be involved, and to be hard and craggy; the body of the testicle may also be enlarged, and the vas deferens will probably be felt to be much thickened, hard, and somewhat nodulated, the other constituents of the cord being normal. There is little pain, but tenderness is complained of on pressure, and the natural testicular sensation is not lost. Very rarely is there any accumulation of fluid in the tunica vaginalis. Upon examination by the rectum, it will be found that the vesiculæ seminales have become involved in the disease, and one or both of these bodies will be felt to be enlarged, thickened, and nodulated. As the disease advances the hardened and enlarged epididymis becomes softened in places and the skin becomes adherent to the testicle at these spots. Now symptoms of suppuration slowly develop themselves; fluctuation becomes apparent. The skin becomes red and glazed, and eventually bursts or is opened, discharging a curdy pus. When the disease has reached this stage, the whole testicle is usually gradually destroyed; other nodules become involved in the suppurating process. If the body of the testicle is involved and abscess forms here, hernia testis, as in the simple chronic orchitis, may take place and the testicle become entirely disintegrated and spoilt. At this time secondary affections may show themselves elsewhere. The disease, extending through the vas deferens to the vesiculæ seminales, may involve the bladder, and frequency of micturition and other symptoms of vesical irritation be set up, and the whole of the urinary tract, including the kidneys, may become implicated. Or the system may become infected generally, and tubercle may be deposited in other organs, especially the lungs, and may terminate the patient's existence. Sometimes, however, under treatment, the suppurating cavity may heal up and the patient entirely recover.

The treatment of tubercular orchitis is not very satisfactory, the disease having a marked tendency to run the untoward course described above. Still much may be done, in a certain percentage of cases, if the disease is

seen and recognised early. Then the general management of the constitutional condition is far more important than any local treatment. Sea-air is of the first importance, and I am convinced that the best thing is to recommend the patient to take a long sea-voyage, where he can obtain plenty of fresh air, and still maintain as much as possible a recumbent position. At the same time, it is desirable that the ship selected should be a vessel which does not carry any female passengers, so that all temptations to sexual excitement should be entirely avoided. It is well, also, that the patient should be provided, if possible, with a deck cabin, so as to avoid breathing the vitiated air of 'below decks' during the night. The diet should be carefully regulated, and cod-liver oil, iron, especially in the form of the syrup of the iodide, and other tonics, should be administered. The testicle should be carefully suspended, and beyond this no local treatment is of much avail. Possibly wrapping strips of lint, spread with iodide of lead ointment, to which a little iodoform may be usefully added, around the testicle, may be useful. By this means the gentle pressure, combined with the sorbefacient effects of the ointment, may assist in the removal of the morbid material. There appears, however, to be a growing feeling on the part of surgeons that in cases of tubercular disease of the testicle, where there is no evidence of disease in any other part of the body, and where the seminal vesicles are not enlarged and indurated, it is better to remove the organ at once, and even, if both testicles are involved, to remove both rather than expose the patient to the risk of the disease infecting the lungs or other organs, or spreading to the urinary tract in the manner described above. There is, no doubt, a good deal to be said in favour of this course, but still it must be in the experience of every surgeon to have seen cases of tubercular orchitis which have entirely recovered, and in which the patient has lived to a good old age, and been the father of healthy children.

When the disease has gone on to suppuration and abscess has formed, as soon as the acute symptoms attending its formation have subsided, and it has degenerated into a sinus, there can be no question, I think, that the best treatment is to enlarge the sinus and scrape out the whole of the cheesy material. This must be done very thoroughly, and great care must be observed to remove every particle of the diseased tissue. The cavity is then to be dusted with iodoform and stuffed with iodoform gauze, when it will frequently gradually close up by granulation. When the testicle is completely disorganised and spoilt, there can be no doubt that the proper treatment is to remove it.

Cystic disease of the testicle: cystic sarcocele: or cystic sarcoma, is an enlargement of the testicle accompanied by the formation of a number of cysts of variable size scattered over the whole organ (Fig. 396). The enlargement is due to a new growth composed of a stroma, made up of connective tissue in all stages of development, in which are spaces lined with epithelium. The cysts are formed by dilatation of these spaces, and the disease bears a strong analogy to the adeno-sarcoma of the breast, and in some cases secondary intracystic growths may be found in the cysts, resembling the cystic sarcoma of the mamma. Cartilage is often found mixed with these tumours, which may run an innocent course, attaining a large size, without causing any serious inconvenience, except that arising from their bulk, or, on the other hand, may become disseminated and reproduced in the internal organs.

The symptoms of the disease are the history of a gradual enlargement, without pain or assignable cause, in a man over the age of thirty. The enlargement

Cystic
disease.

sometimes attains a considerable size before the patient's attention is drawn to it. The organ is smooth, elastic, and there is as a rule absence of testicular sensation. The chief difficulty is its diagnosis from hydrocele, where the latter is not translucent and the sensation of fluctuation is not evident. Here the chief reliance must be placed on the shape of the tumour, which is not pyriform like a hydrocele; upon the detection of the testicle at one part of the swelling in hydrocele; by its special sensibility, and the absence of this sensibility from every part of the swelling in cystic disease. And if any doubt should remain the introduction of a trocar will at once establish the diagnosis, in the one instance giving exit to the characteristic fluid of hydrocele, and in the other to a few drops of mucoid or sticky fluid mixed with blood. The only treatment in these cases is removal of the organ.

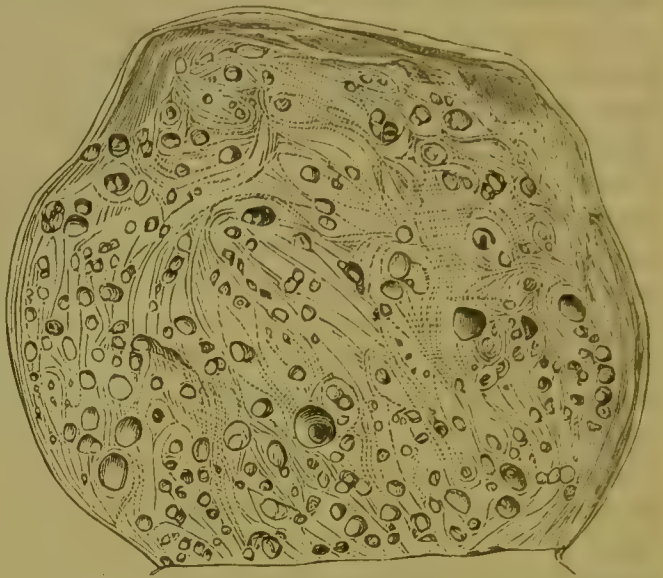


FIG. 396. Section of a specimen of non-malignant cystic disease of the testicle.—From a preparation presented by Mr. Cæsar Hawkins to the Museum of St. George's Hospital.

Sarcoma.

Sarcoma is a not uncommon disease of the testicle, but has been in many cases until recently known as enchondroma of the testicle, from the great proneness which the sarcomatous tissue exhibits to undergo chondrification, so that when the organ is removed from the body the entire mass of the tumour appears to consist of cartilage, covered over merely by a thin layer of softer embryonic material. The disease is, however, indubitably a true sarcoma which has undergone developmental changes, as pointed out in the chapter on Tumours (p. 373), and ought never to be termed a chondroma or a chondro-sarcoma, but a chondrifying sarcoma. In addition to these, pure sarcoma, generally of the small round-celled variety, in which this tendency to chondrification does not exist, are very occasionally met with, especially in young children. And, on the other hand, pure enchondromata, without any sarcomatous tissue, are described as rarely occurring. The chondrifying sarcoma is a malignant tumour, growing rapidly; it is hard, bossy on the surface, frequently undergoes cystic degeneration in its centre, and then constitutes another form of cystic sarcoma.

Cancer of the testis.

Cancer of the testicle is usually encephaloid, but some cases of scirrhus have been described. It generally begins in the body of the gland, expanding the substance of the testicle, which is then spread out as a thin layer over the tumour, easily known from the cancerous mass by the seminal tubes, which form the bulk of this expanded layer, as well as by its general appearance. As it increases in size, which it does with considerable rapidity, it usually obliterates in great part or entirely the cavity of the tunica vaginalis. The scrotum becomes distended, reddened, and covered by dilated tortuous veins and adherent to some softening spot in the tumour. The skin then gives way and a fungous protrusion takes place, which increases rapidly and bleeds freely, constituting what was known by the older authors as fungous

hæmatodes. It tends to spread up the cord, which becomes enlarged and thickened, and into the lumbar glands, i.e. the glands which lie around the aorta and common iliac arteries. The inguinal glands are also sometimes affected, and that not only when the skin of the scrotum is implicated. As the disease progresses (and its progress is usually rapid) the patient's health breaks down rapidly, and death ensues either from the pressure of the mass in the abdomen, or from its interference with digestion, or from fungation, whether of the secondary tumour or the primary.

The diagnosis rests mainly on the fact that cancer is a rapidly increasing solid enlargement of the testicle itself, unaccompanied by inflammation; but the remarks made above in the sections on hæmatocele, chronic and scrofulous orchitis, will show that this diagnosis is by no means easy in the early stage; for at this period there is no cancerous cachexia nor any perceptible enlargement of the glands. There is no difficulty in forming a correct opinion in the latter stage of cancer, but then the time for surgical interference will probably have passed. However, with a rapidly increasing solid swelling an exploratory incision is justifiable, all the necessary arrangements for castration having been made. Diagnosis.

The operation of removing the testicle is a very simple one, and free from danger; at least, I cannot recollect a single case of death after the numerous operations of the kind which I have performed and witnessed, though these operations have been performed chiefly on patients exhausted by illness and dissipation, and in those metropolitan hospitals which are falsely said to be so unhealthy. Castration.

A free incision is to be made from the situation of the external inguinal ring down to the bottom of the scrotum. The cord is then exposed and the skin peeled off it with the fingers. If the cord should be diseased up to the external ring, a director must be passed into the spermatic canal, the aponeurosis of the external oblique divided, and the cord followed higher up; but this is very seldom required in any case which the surgeon has selected for operation. The healthy part of the cord is to be caught in a clamp, such as is figured on page 657, and when it has been entirely secured it is divided above the disease, and as far from the clamp as circumstances permit. Then the tumour is rapidly shelled out of the scrotum, and if it adheres to the skin all the adherent portion of the latter is removed, as well as a good part of the skin in the neighbourhood. The cutaneous vessels which are large enough to give any trouble are tied, and then the ends of the cut vessels in the cord are picked up and tied. If this is done with the carbolised gut, and the ends of the ligatures cut short, the wound will often heal almost or altogether by first intention.

If a clamp is not at hand, the cord, if it be healthy for a considerable distance below the ring, may be held between the thumb and finger of an assistant with a piece of rag; but this is a very inferior method of securing it. Or the old plan of passing a stout ligature through it to hold it by may be adopted, and, in fact, must be if there is not room to hold it otherwise. I have often seen the cord on its division slip from between the assistant's fingers up into the spermatic canal, and then there is very profuse bleeding, and the surgeon has to slit up the canal and follow and bring down the bleeding stump of the cord with hooked forceps. This danger is avoided by the clamp, provided the division of the cord is not made too close to it, in which case the clamp also is very likely to slip off. I have frequently followed the old plan of tying the whole cord with a strong double ligature,

and have not found any of the evils, such as pain, tetanus, &c., which are said sometimes to result from it; but it is a tedious method, as it delays the patient's convalescence, and condemns him to suppuration and confinement to bed during the long period of separation of the ligature. Abroad, the cord is sometimes divided with the *écraseur*,¹ but this is not a plan which I can recommend, as it takes a very long time, and is far more exposed to the risk of reactionary or secondary hæmorrhage.

Before the operation the patient should be carefully examined as to the presence or absence of hernia. Unfortunately the immunity from disease which this operation procures in cases of cancer can only be expected to be short. The disease will recur in the stump of the cord, or in the lumbar glands, or in some cases in the opposite testicle, or in remote parts of the body. Still the respite is one usually of complete health, and it amply justifies the operation, even if we believe that life is not prolonged by it. No doubt also in some cases the recurrence is long delayed. Mr. Curling has given four cases in which the patients were well 4, 9, 10, and 12 years after the operation.

Spermatorrhœa.

The consequences of masturbation, the apprehensions of spermatorrhœa, and loss of sexual power form a highly unpleasant subject, which has become still more disgusting as affording a field for the practices of some of those unscrupulous and degraded charlatans who infest the profession, or who falsely assume a connection with it. These men make money out of the fears of unfortunate youths, some of whom are merely nervous and are frightened at the natural emissions by which the testicles relieve themselves from distension in persons who are not in the habit of sexual intercourse. The majority, however, of the victims of such fears are conscious of having indulged either in solitary abuse or in sexual excesses. A judicious and honourable surgeon cannot be better employed than in delivering such patients from the consequences of unfounded apprehensions, and inculcating the strength of mind and manliness necessary to give up vicious habits which may have been contracted. In a work of this kind it is fortunately unnecessary to dwell on this unsavoury subject. So long as the power of complete erection continues and the patient does not lose semen involuntarily or unconsciously (which is very rare) the genital organs will recover themselves under proper treatment. Very frequently what is mistaken for spermatorrhœa is some slight mucous discharge, the result of irritation of the urethra. Proper treatment, however, involves as its most essential feature the renouncement of the habit of self-abuse, and either abstinence or only moderate indulgence in sexual intercourse. If the patient cannot be persuaded to put this restraint on himself he deserves the ruin that will fall on him. With this, and with tonic regimen and active exercise of body and mind, recovery will be regular and permanent. Real impotence may, of course, occur; but it is very rare. The cauterisation of the prostatic urethra, which is so highly recommended, seems to me often useful, less perhaps from its direct action than indirectly, by making masturbation or venereal excitement painful.

On the whole of this subject, and especially on the morbid fears of impotence and other horrors which haunt the unfortunate victims of 'sexual hypochondriasis,' I cannot do better than refer the reader to Mr. Jacobson's

¹ See a case in the '*Gaz. des. Hôp.*' Oct. 30, 1877.

remarks on 'Functional Disorders of the Testicle and the other allied topics,' op. cit., p. 549 et seq., and to Sir J. Paget's excellent essay on 'Sexual Hypochondriasis,' in his recently published Clinical Lectures.

AFFECTIONS OF THE CORD.

VARICOCELE is a very common affection, at least in its minor degrees. It consists, as its name implies, in a varicose condition of the pampiniform plexus of veins which return the blood from the testicle into the spermatic vein. Varicocele is far more common on the left than the right side. Various causes have been assigned for this. The left spermatic vein opens into the renal vein at a right angle, while the right spermatic opens into the vena cava obliquely, and it seems possible that this disposition may be somewhat more unfavourable to the circulation in the left vein; but at the most it can only favour the production of the disease; it cannot produce it. Again, the left testicle is usually a little lower than the right, and the vein a little longer. But this difference seems too insignificant to be of any importance. Thirdly, there is the fact that the left renal vein is exposed to the pressure of the fæces in the sigmoid flexure, behind which it lies; and this appears a possible cause of obstruction in the vein. Mr. Gould, in an interesting paper in the fourteenth vol. of 'Clin. Trans.,' conjectures with much probability that the cause of varicocele (which frequently shows itself about puberty) may be some over-development of the veins, or 'a transference of the developmental stimulus of puberty from the testicle to the veins.' It appears often to be caused by the practice of masturbation. The enlarged veins are easily felt in the cord, 'feeling like a bag of worms,' as it is always described, and the description is very accurate as applied to the extreme instances of the affection. When the varicose veins are at all large they can be seen and the disease at once recognised without even touching the skin. Varicocele may be complicated with any other affection of the testicle, or with hernia; but it can hardly, as far as I can see, be confounded with any of them, at least by any one who has ever seen it before. The swelling, of course, subsides to some extent in the recumbent and increases in the erect posture; but this is utterly unlike the disappearance and return of a hernia. When the veins are large a certain amount of impulse can be felt on coughing.¹

The enlarged veins are often the seat of some amount of real pain on prolonged standing, and still more often of a considerable amount of nervous pain. The testicle on that side is often smaller than the other, and the patient is often worried (especially if he has fallen into dishonest hands) by apprehensions of impotence. As a general rule, however, nothing can be more unfounded.² Sir A. Cooper said with much truth: 'Varicocele should scarcely receive the title of a disease, for it produces in the greater number of cases no pain, no inconvenience, and no diminution of the virile powers.' It follows incontestably, if we believe this—and there are few surgeons of experience who would question it—that the number of cases of varicocele

¹ I must content myself with a mere reference to a variety of varicocele described by Profs. Monod and Terbillon in the 'Arch. Gén.' July 1879, as a concomitant of lymphadenoma affecting the testicle. The subject appears at present to be imperfectly understood. The authors believe that lymphadenoma is the only form of new growth which attacks both testicles at once.

² Sir J. Paget goes so far as to say of varicocele: 'I do not believe that it ever produced wasting of a testicle, or impotence, or any such thing.'—'Clin. Lect.' p. 274.

which require serious treatment are very few indeed, and that any surgeon who operates very frequently for varicocele must operate on many cases which he would have done better to let alone. I do not deny that such operations may sometimes be required, under circumstances which I will immediately point out; but the great majority of cases require nothing but a bag-truss. If the enlarged veins should inflame, rest in the recumbent posture with the testicles raised by a small pillow, fomentation, and leeches are indicated. There are cases (probably those in which the upper part of the vein is varicose, and where the enlargement of the lower veins depends on the pressure of the column above) in which a light truss applied on the ring gives relief. Mr. Wormald's plan of drawing a part of the scrotum through a ring of soft metal coated with leather, the ring to be pinched together when the skin has been drawn through it, may be tried; and some surgeons still have confidence in Sir A. Cooper's method of removing all redundant scrotum and sewing it up, so as to give support to the testicle, which, however, must still be also supported by a bag-truss. Nervous pain may be much relieved by convincing the patient of the trivial character of the disease.

Operations
for varico-
cele.

There will remain cases in which the patient will wish for an operation, and that mainly for three reasons—either that he wishes to get into some employment, as the army, from which the state of the veins excludes him (though I believe army-surgeons do not reject recruits for the slighter degrees of varicocele), or he suffers real and considerable pain, or the testicle is wasting. As to the latter part, however, I do not think that any slight difference between the size of the testicles is necessarily a motive for operation. Several years ago I was consulted by a young man with varicocele, who was very anxious to be operated on, the varicocele being rather large and the testicle much smaller than the other. With difficulty I persuaded him to wait, and then, as the testicle did not continue to waste, I advised him to give up the idea, telling him that he might safely marry (as he wished to do), and might rely on it that he had the same chance of offspring as any one else. He is now the father of a large family, and suffers nothing from his varicocele, which has remained stationary. And we must recollect that such operations are by no means free from danger to life, and that if they sometimes cure the atrophy of the testicle, on the other hand they sometimes produce it. The celebrated instance of Delpech is in point. He was assassinated by a man on whom he had operated for varicocele on both sides, and who had lost sexual power in consequence of the operation. The assassin was executed, and on examination of his body after death both testicles were found flaccid and wasted. This untoward result arose, doubtless, from obliterating the greater part of the spermatic artery along with the veins. Usually the trunk of the spermatic artery adheres so closely to the vas deferens that as the latter is drawn out of the way of injury the artery follows it and escapes also; but often in dividing the veins a large artery is severed, and the distribution of the spermatic artery is by no means uniform. Numerous cases of death after the operation are known to have occurred; and in cases which ultimately recovered I have seen so much suppuration, sloughing, and other evil consequences, that I have thought the remedy has been much worse than the disease. I would therefore recommend the surgeon to let his patient urge the operation upon him, and even then only to consent when his judgment goes along with the request.¹

¹ See also on this subject Paget, *op. cit.* p. 68.

The operation I have generally practised for varicocele is that recommended by Mr. H. Lee, and which is the same as that which he employs in varicose veins of the leg. The vas deferens is to be carefully isolated and held aside ; then two needles are to be driven in beneath the enlarged veins and above the vas deferens at a distance of about an inch from each other. The veins are to be compressed between these needles and the skin by a figure-of-8 ligature wound pretty tightly over the needles, or by an india-rubber band. In the latter case the needle is introduced with the band strung on it, and the band then passed over its point. When the veins are thus secured they are divided subcutaneously in the interval between the needles. In doing this a good deal of bleeding often takes place. This is judged to be arterial when it comes from the upper or cardiac end, and venous from the lower. If it is too great to be stopped by the circular band of strapping which is applied between the needles, another needle must be driven in more deeply, either above or below the former (according as the hæmorrhage is arterial or venous), so as to command the vessel which has escaped the needle previously put in. The needles are to be withdrawn in about four days. If matter forms in the scrotum it must have early exit.

Many other operations for curing varicocele are, however, in use. Latterly I have adopted the very simple plan of cutting down on the venous plexus as though it were an artery, by a very small incision, separating it from the vas deferens, and tying it with a kangaroo-tendon. The wound heals over the ligature, which remains buried in the tissues. I lately saw a man so operated on, who seemed to be permanently cured, and the method is so simple and painless that I think it deserves further trial, though my experience is not enough to justify me in speaking confidently about it. Mr. Jacobson (op. cit. p. 570) describes an operation introduced by his colleague, Mr. Howse, in which the varicose portion of the cord is included between two carbolised gut ligatures and excised. This is, however, obviously a very severe proceeding, and Mr. Jacobson records a case in which it was followed by gangrene of the testis. I have seen a similar proceeding adopted without any antiseptic precautions many years ago, in which there was profuse bleeding at the time, and extensive suppuration afterwards.

Fatty tumours are occasionally, though very rarely, found in the tissue of the spermatic cord, which very closely simulate omental hernia. The diagnosis can only be formed by very careful examination, showing that the tumour is movable by traction on the cord, and that the fingers can be made to meet round its base ; but I am not aware that these tumours have ever been made the subject of operation. Mr. Jacobson refers to two cases from Mr. Curling's experience, and to some preparations of fatty and fibrocellular tumours of the cord in the Museum of the College of Surgeons.

Tumours
in the
spermatic
canal.

The vesiculæ seminales are occasionally, though very rarely, the seat of acute inflammation and abscess, which in one of the cases recorded proved fatal by inducing peritonitis,¹ in another was cured by timely incision through the rectum.² Remembering these cases, the surgeon should carefully examine the parts in any case in which pain, fever, tenesmus, and shooting pains down the limbs render the occurrence of acute inflammation of these organs probable.

Affections
of the
vesiculæ
seminales.

Apart from this rare occurrence, the affections of the seminal vesicles are rather matters of diagnostic than therapeutical interest. In tubercular

¹ Mitchell Henry, 'Med.-Chir. Trans.' vol. xxxiii. p. 307.

² Jacobson, op. cit. p. 573.

disease of the testes or bladder the vesiculæ are often the seat of tubercle, and it has now become usual to examine them from the rectum in affections of the testis believed to be of this nature. Prof. Humphry has also met with chronic enlargement of the vesiculæ, and a case is reported in which it was believed (but, it seems to me, on very imperfect evidence) that they were dilated into a large tumour (Jacobson, loc. cit.). Calculus concretions are also said to have been found in them.

AFFECTIONS OF THE SCROTUM.

Œdema
and inflam-
mation.

THE scrotum is very liable to passive œdema both from general and local causes. The chief point in the management of such affections is to see that gangrene is averted by timely punctures and fomentation. Inflammatory œdema also tolerably often occurs from erysipelas, from the contact of urine, and from other causes; and sometimes an abscess forms in the cellular tissue of the scrotum and produces swelling quite out of proportion to the amount of matter in it. An abscess containing only a few drops of pus will often form a large swelling which gives the patient very grave uneasiness, and which I have even known mistaken by the inexperienced for a tumour. Nothing is required but a poultice and a timely puncture, after which the swelling will rapidly subside.

Elephanti-
asis of the
scrotum.

Elephantiasis of the scrotum is a disease of tropical countries, which is only seen here, as far as I know, in those who have contracted it abroad. There it extends to an enormous size, making the patient's life intolerable, in consequence of its weight preventing him from any of the necessary exertions of daily life, and rendering any operation, however desperate, justifiable.

The opportunity of seeing these cases in their early stages, when they might be amenable to pressure or to astringent applications, is hardly ever granted. In the more moderate condition, the surgeon would probably think it better to dissect out all the hypertrophied skin and remove it from the penis and testicles, even if these organs were exposed. Granulations would cover them, and the patient would in all probability be restored to perfect health.¹ The disease appears often to commence with the lymphatic hypertrophy to which reference has been made on p. 609, and is often associated with enlargement of the glands in the groin. It is believed to be often produced by the irritation of the jigger-worm (*Filaria Medinensis*) in the tissues, and from thence the worms pass into the blood, so that their young can be detected in the blood from any part of the body, or in the lymph which exudes from the distended lymphatics of the scrotum.

I append a representation of the early stage of elephantiasis caused by lymph-scrotum, which I owe to the kindness of Dr. Rennie of Fow Chow. The patient was a man æt. 24. After the removal of the hypertrophied scrotum, the glandular enlargement rapidly subsided, but the parent worm was not found in the excised scrotum, and its young were still present in the blood after the patient's recovery. When the disease has attained an enormous size, and it is nevertheless thought right to remove it, no dissection is possible, on account of the excessive hæmorrhage. The patient should

¹ Two interesting cases were lately reported by Dr. Lloyd, of the Indian Army, in which tumours 65 lbs. and 61 lbs. in weight respectively were removed with success, and the penis and testes dissected out of the mass. In one of these cases the exposed testes hung down nearly as low as the ankles after the operation, yet on convalescence they had completely retracted to the normal level.—'Lancet,' Aug. 29, 1874.

lie on his back for about half an hour before the operation with the tumour raised, in order to drain it of blood ; then the mass must be embraced in a temporary ligature, or in a clamp, in order to restrain the bleeding as far as possible, and the whole mass be removed as quickly as may be, without regard to the genital organs. Such operations, however, are very fatal.¹

Cancer of the scrotum—soot-cancer, or chimney-sweep's cancer—is an epithelioma which arises from the irritating properties of coal-soot. Wood-soot is not so irritating, and therefore will not usually excite the disease. Hence it is nearly unknown in countries where fires are mostly made of wood ; and, on the other hand, it is not entirely confined to chimney-sweeps in this country, but affects also people who deal much in soot, as gardeners—witness the well-known instance recorded by Earle of the gardener who habitually carried a bag of soot over his arm to dress his beds with, and was affected

Cancer
scroti.

with soot-cancer on that arm. No doubt the development of this epithelioma is due mainly to the continuance of the irritation, so that constant removal of the soot will hinder it. And therefore in the present day, when people know more of the value of cleanliness, and when even chimney-sweeps wash themselves, this disease has become rarer than it used to be. In fact, it might probably be banished by the sweep using always a clean or freshly-brushed suit, and thoroughly washing himself whenever he comes home.

As usually seen it forms a foul epitheliomatous ulcer on one side, or sometimes on both sides, of the scrotum, with hard prominent granulations and raised irritable edge, very frequently complicated with enlargement of the inguinal glands, and in some cases (but rarely) spreading inwards so



FIG. 397. Lymph-scrotum.

as to affect the coverings, or even the body, of the testicle. The diseased tissues must be freely removed, and it is justifiable to do this at any period of the disease, provided the whole of the morbid tissue can be comprised in the incision, even though the testicles should be entirely denuded, or though it should be necessary to remove them as well as the diseased skin. The enlargement of the inguinal glands, if not excessive, constitutes no bar to

¹ Perhaps I should rather have said, 'were very fatal in past times.' I would refer to an interesting paper by Dr. Turner, late medical missionary at Samoa, on one hundred and thirty-eight cases of this operation, with only two deaths.—'Glasgow Med. Journ.' 1882.

the operation, nor does it even necessitate the removal of the glands themselves. Constant experience shows that on the removal of the epitheliomatous ulcer the enlarged glands will subside. But if the glands are unusually large and hard it is better to excise them at the same time.

If after the removal of the scrotum the flaps of skin can meet over the testicles without much traction the wound should be united. But if not, granulations will cover the testicles, and the cicatrix will form an excellent substitute for the scrotum.

Dermal
and other
foetal
tumours.

Congenital tumours containing bone, teeth, hair, and other structures are of occasional occurrence in the scrotum. They are sometimes, as it seems, at first included in the testicle itself out of which they grow; but at other times they have been proved to be separable from the gland. The diagnosis is usually obscure until suppuration sets in around the mass and exposes a part of it, or till the whole tumour has been removed. This should be done in all cases; for though they have been spontaneously extruded, yet operative removal is far less dangerous and distressing. In the operation, it is reasonable to make an attempt to preserve the testicle, though it will sometimes be found impossible to do so.

Hydatids
in scrotum.

One case at least is on record (by Mr. Muskett of Sydney¹) in which a large hydatid cyst in the scrotum was mistaken for a hydrocele and was treated as such for several years. Ultimately the sac came away through the hole made by the trocar, which had suppurated. The diagnosis seems to have been hardly possible in this case, to judge from Mr. Muskett's account; but a free incision, which seems to me the best treatment for any case of supposed hydrocele after recurrence, would clear up the diagnosis, and would at the same time effect a cure.

Innocent
tumours in
the
scrotum.

Innocent tumours other than inflammatory are decidedly rare in the scrotum, but cases of fatty, fibrous, and sebaceous or other cystic tumours have been described. I have recorded² an instance of a fibrous tumour of the scrotum enveloping the testicle, but clearly having no organic connection with it, which had grown gradually during thirty-three years. This might doubtless have been removed without injury to the testicle at an early period, but was so implicated with the cord and gland at the time I saw it that they were necessarily removed together. As well as could be determined, the tumour seemed to have grown in the tunica vaginalis. Several such instances are recorded, and it may be said in general that the fibrous tumours of the scrotum are developed apart from the testicle, though their removal often involves that of the gland.

AFFECTIONS OF THE PENIS.

Cancer.

CANCER of the penis is also usually epithelial, and, like cancer of the scrotum, is commonly excited by some irritation, of which the secretion retained behind a congenitally phimosed prepuce is a well-known instance. This liability of persons with congenital phimosis to cancer of the penis forms one motive for circumcision in such cases, though ordinary considerations of cleanliness would be quite sufficient without any such motive.³

¹ 'Australian Med. Gaz.' December, 1886.

² 'Path. Soc. Trans.' vol. xx. p. 246.

³ Sir J. Paget has, however, pointed out that in many cases the orifice of the prepuce may be so stretched by constant gentle traction that the glans can ultimately be exposed and the operation avoided.

The only special point in the surgery of cancer of the penis is to distinguish it from secondary or tertiary syphilitic ulceration of the glans penis. And there can be no doubt that in many cases the penis has been amputated for supposed cancer which has been only this form of ulceration, and that many of the cases of permanent recovery after amputation for supposed epithelioma have been of this nature. In some cases, again, a confusion may have been made with common warty growth, though this is less likely. The characteristic hardness around the sore and the hard surface, indurated edge, and prominent granulations of the epitheliomatous ulcer will distinguish it from the syphilitic ; or if any doubt remains, in consequence of the history or the co-existence of tertiary syphilis, a gentle and prolonged course of mercury will settle the question ; and this is best administered in the form of vapour. Sometimes melanotic deposit is mixed with the cancer of the penis, as in a remarkable case which I communicated to the Pathological Society a few years ago, and which is figured above on p. 371.

When the diagnosis of cancer is clear, the removal of the whole penis at a level well behind that of the disease is imperative.

Amputation of the penis.

The old rough plan of simply cutting the organ off, with the loss of a large quantity of blood from arteries which the surgeon proceeded afterwards to tie, leaving his patient exhausted by hæmorrhage, would now be unjustifiable. The penis is to be constricted by a clamp (see p. 657), by means of which it can be removed with the loss of only a few drops of blood, and all the vessels whose mouths can be discerned are to be tied. Then the clamp should be slightly relaxed, and new vessels will perhaps be found which require ligature. Finally, the affair is complete without any hæmorrhage, or with very trifling loss, and the patient generally recovers without any serious symptom. But unless some care is taken to prevent the cicatrization of the cut end of the urethra, a most painful stricture will result, and I have seen the orifice of the urethra contracted to the size of a pinhole. This, however, is the result of unpardonable negligence. Always, after amputation of the penis, as soon as the bleeding is suppressed, a director should be passed down the urethra, and the tube should be slit down with scissors on its upper aspect for about half an inch. Hilton used to recommend that the urethra should be incised on its lower aspect ; but if this is done the urine is directed downwards on to the boots during micturition ; whereas if the urethra is slit on its upper aspect, a sort of channel is formed which carries the urine away from the patient. Then the flaps of mucous membrane should be picked up and attached to the skin, whereby a large valvular opening will be left, that will show no tendency to contract. The old plan of passing bougies constantly to keep the end of the urethra from contracting is painful and far less efficient.

In some instances the operation above described is not sufficient to remove the whole of the disease in cases where it is far advanced, and it then becomes necessary to remove the whole penis by separating it from its attachment to the pubic arch. The plan usually adopted is that suggested by Mr. Pearce Gould.¹ The patient having been placed in the lithotomy position, an incision is made round the root of the penis and carried down the median line of the scrotum as far as the perinaeum. The two halves of the scrotum are then separated from each other by tearing through the interspace between them with the fingers and handle of a scalpel. A catheter having now been intro-

¹ 'Lancet,' 1882, vol. i. p. 821.

duced into the bladder as a guide, the membranous portion of the urethra in front of the triangular ligament is separated from the corpora cavernosa and divided, after the withdrawal of the catheter, just behind the bulb. The penis is now to be freed from its attachments. The suspensory ligament is to be divided above, and the crura by which it is attached to the pubic arch exposed. These are to be separated from the bone by a periosteal scraper and the whole penis thus removed. The remains of the urethra is now to be slit up for about half an inch and its edges attached to the skin at the posterior extremity of the incision in the perinæum. The remainder of the wound is to be brought together, free drainage being provided for.

Circum-
cision.

Congenital phimosis¹ should always be treated by circumcision. It is a malformation which often leads to considerable irritation, causing many of the symptoms of stone in the bladder, and, as stated before, it undoubtedly predisposes to epithelioma. In some rare cases stones form in the phimosed prepuce. In a case mentioned by South² there were over two hundred small calculi. Mr. Croft³ gives two cases which occurred in natives of the Solomon Islands, where congenital phimosis is said to be almost universal. In one there were twenty-two stones, in the other a single stone weighing over an ounce.

The operation of circumcision is a very easy one and requires no special apparatus. The prepuce is drawn slightly forwards and grasped by an ordinary pair of dressing-forceps just in front of the glans. With one sweep of the knife the portion of the prepuce in front of the forceps is then removed. Upon releasing the forceps it will be now seen that a belt of skin has been removed and that the mucous membrane still encircles the glans. A pair of elbow scissors are to be introduced into the orifice of the prepuce and the mucous membrane slit up on the dorsum of the glans penis as far as its attachment at the corona glandis. It is now turned backwards, and may be united to the skin incision by a few catgut sutures. This is, however, not necessary; if it be turned back and a strip of lint soaked in carbolic oil (1 in 20) be applied around the wound it will in all probability heal without any further trouble. By performing the operation in this way the cicatrix is removed from the extremity of the prepuce, and thus all chance of future contraction is avoided. In congenital phimosis the mucous surface of the prepuce will often be found to be adherent to the glans: under these circumstances it must be carefully and thoroughly freed up to the corona glandis before the operation is completed. When sutures are used catgut should always be employed, especially in children, as they will dissolve of themselves, and thus the necessity of removing them is avoided—a proceeding which is attended with pain to the child, and is often tiresome to the operator on account of the difficulty that there is in keeping the child still during its performance.

Other affec-
tions of the
penis.

A few cases of persistent priapism have been recorded from obscure causes, which are best treated by low diet, tartar emetic, or bromide of potassium. In other cases priapism results from disease or injury of the nervous centres, from irritation of the urethra or prostate, or from injury during connection. The treatment in these cases must be directed to the cause.

¹ In a curious case mentioned in the 'Brit. Med. Journ.' 1878, vol. i. p. 335, the prepuce is said to have been congenitally imperforate. The malformation was easily remedied.

² See South's 'Chelius,' vol. ii. p. 633.

³ 'Chir. Soc. Trans.' vol. xviii. p. 8.

Gangrene has been known as one of the sequelæ of typhus fever, or from paraplegia : a remarkable case of spontaneous gangrene of the penis, followed by recovery, is recorded by Mr. Partridge in the twentieth volume of the 'Medical Times and Gazette' ; and two others by Dr. Coward of Huddersfield, one fatal, the other terminating in recovery after amputation, will be found in the 'British Medical Journal,' Sept. 4, 1886.

CHAPTER XXXIX.

SURGICAL DISEASES OF THE FEMALE ORGANS OF GENERATION.

THE diseases of the female organs of generation which come within the province of the surgeon are as follows :—

Malforma-
tions; ad-
hesion of
the labia.

The commonest malformation (if it deserve so grave a name) is the closure or adhesion of the labia, which is often seen in infants, and sometimes passes undetected, so as to be presented to the notice of the surgeon in later childhood. Very rarely it is allowed to persist till puberty. It is not unfrequently confounded with imperforate hymen; but the mistake ought not to be committed; for the adhesion is between the labia majora quite in front of the hymen, and it is not, at least in the early years of life, in any sense membranous. After years of neglect it may become tougher and require division with a knife and director; but usually all that is necessary is to pull the parts asunder forcibly, and prevent readhesion by keeping the labia separated with a piece of oiled lint.

Imperfor-
ate hymen.

Imperforate hymen is a much graver malformation, especially if (as is almost always the case) it escapes detection in infancy, and the patient first applies for advice when the collection of the menstrual fluid has considerably dilated the cavity of the uterus. Under these circumstances any slight operation, though it is indispensable, involves serious danger. Hence the advice usually given in such cases, to wait for operation till after puberty, seems quite erroneous. If the condition of the parts is discovered in childhood, it is easy and perfectly safe to remove a small portion of the hymen, so as to make an opening into the vagina. But when the uterine cavity becomes distended with menstrual fluid, or with the treacly inspissated remains of such fluid, it is often noticed that after an opening has been made in the hymen the uterus is thrown into spasmodic action, and the Fallopian tubes, which are dilated as well as the uterus, often give way under this action, causing extravasation of the fluid into the peritoneal cavity, and fatal peritonitis. Or, according to some authorities, a reversed peristaltic action of the tubes is excited by the escape of fluid, and some of it is forced backwards through the tubes into the peritoneal cavity. Blood-poisoning may also follow from the decomposition of some of the fluid, which may not have been got rid of by the muscular contractions.

Imperfor-
ate vagina.

The point of chief importance in these cases is to decide whether the case is merely one of imperforate hymen, or whether the vagina is itself imperforate, and, if so, whether the uterus is present or absent. Mr. Jonathan Hutchinson speaks on this head as follows: 'When there is evidence of the retention of menstrual fluid, and therefore of the presence of a uterus, and probably of a vaginal cavity above the occlusion, the case will come fairly under surgical treatment. In the first place, the character of the obstructing medium must be determined. If the obstruction be found within an inch or two inches of the vulva, and if it be constituted by a membrane, stretched across an otherwise well-formed vagina, the case is probably one of imperforate hymen. In some of these, during coughing, the propulsion of the fluid

downwards may easily be felt, or the distended membrane may even be forced as low as the vulva itself.' ¹

When the obstruction is of only slight thickness there is no difficulty about the treatment. The patient being secured in the lithotomy position, a puncture is made into the collection of fluid, and this is enlarged with the fingers, director, and forceps. It seems that a free opening is safer than a small one, as rendering the forcing action of the uterus less likely to act on the Fallopian tubes. If the obstruction be of considerable extent, a very careful dissection in the direction of the supposed upper part of the vagina must be undertaken, assisted by the finger in the rectum and by a staff in the bladder. If this has to be done deeply, the deeper incisions are more safely made horizontally; but in such cases the operation is doubtless both embarrassing and dangerous.

I do not speak here of cases of doubtful sex, since it is only in the rarest possible circumstances that any surgical treatment is required, and advice as to the sexual relations lies more in the province of the accoucheur.

A very troublesome affection, and one which is sometimes very difficult to treat, is the small vascular tumour, or urethral hæmorrhoid, which is sometimes found surrounding the meatus of the female urethra. In structure it much resembles a nævus. It occasions a good deal of pain and irritation; leads to a troublesome frequency in micturition; renders sexual intercourse very painful, sometimes impossible, and often bleeds a good deal. Though the disease appears trifling, it is often very difficult to cure, recurring again and again, even after apparently complete removal. Three methods of treatment are in use—caustics, the ligature, and excision. The first are often successful if freely used and if sufficiently strong. The pure nitric acid, repeatedly applied, will often ultimately eradicate the growth, with little pain and no risk or confinement to bed; but it often fails. The actual or galvanic cautery is perhaps more efficient, but requires anæsthesia for its application. If only a portion of the circumference of the meatus is involved in the growth, the latter may be encircled in a ligature passed deeply under its base, through healthy tissues, care being taken to keep the urethra open while passing the ligature, so that the opposite wall of the canal may not be included in it. But the most efficient plan is to dissect the growth out completely with the knife or scissors, taking care to carry the incisions through healthy tissues. No formidable bleeding need be apprehended; but even after this operation I have seen the growth return, and if it be necessary to cut deeply there is often partial incontinence of urine, i.e. the patient is obliged to attend to the first desire to empty the bladder, otherwise the urine will very soon pass in spite of her.

Vascular
tumour of
urethra.

Cystic and other innocent tumours are not uncommon in the tissue of the labium. The cysts are probably always, and certainly they usually are, formed by the obliteration of the duct of a mucous follicle, as is often seen in the mouth. This is sometimes the result of irritation, so that they are not unfrequently developed soon after marriage. They contain a glairy mucus, and they are only troublesome if the patient is in the habit of sexual intercourse, or if they inflame and suppurate, which will occur occasionally. They may be dissected out entirely, or they may be often cured by laying them freely open and stuffing the orifice with lint; or still more certainly by

Tumours of
the labia.

¹ 'Syst. of Surg.' 3rd ed. vol. iii. p. 394.

clearing away all the secretion and rubbing the interior with caustic. The recommendation of the treatment by laying the cyst open is that it does not render the employment of chloroform necessary, nor are any assistants required. The removal of the entire cyst is, of course, more certainly successful.

Fibrous tumours also form in the labium, and are frequently allowed to attain an enormous size. They then become pendulous, and greatly interfere with all movements, as well as with the functions of the parts. Their removal is sometimes attended with much hæmorrhage, and when this is apprehended in consequence of the size of the mass or its vascular appearance it is prudent to control the bleeding by a temporary ligature or clamp passed round the base of the tumour beyond the part at which it is removed.

With regard to condylomata, mucous tubercles, and other syphilitic affections of the labium, I do not know that I need add anything to what will be found in other parts of the work.

The tissues of the labia and clitoris are sometimes so much hypertrophied by the constant recurrence of inflammation (whether syphilitic or not), or by elephantiasis, that it becomes necessary to remove the diseased part. In such a case the surgeon should be prepared for free hæmorrhage, and, as the base of the growth is usually too extensive to be included in a clamp, the best plan is to pass a number of stout harelip pins through it, and, having removed the diseased tissue pretty close to these pins, and tied any large vessels, to pass the twisted suture round the pins tightly enough to restrain any further oozing : or the mass may be removed with the galvanic *écraseur*.

Cancer of the external parts is almost always epithelial. It may occur as a primary disease, and then usually in later life, or it may be developed on a venereal ulcer. It rapidly affects the inguinal glands. Its diagnosis from tertiary syphilitic affection rests on the diffused hardness and irregular surface of the ulcer, and on the affection of the glands, as well as on the history. From rodent ulcer, which is sometimes, though rarely, found in the same situation, it is distinguished by the distinct deposit which is found in epithelioma ; but the diagnosis is not of very great importance, since both require the same treatment. Early and complete excision is urgently demanded ; although there is great probability of return, much more so than in the analogous disease of the scrotum. The enlarged glands should be removed at the same time, if they are decidedly indurated. When the patient will not submit to the removal by the knife, the use of caustics must be substituted, but is decidedly inferior.

Rupture of the perinæum is an accident following on parturition, and in its highest grades constitutes a serious infirmity which imperatively calls for a surgical operation. The slighter ruptures can often be brought to heal at once by bringing the parts together with a stitch and keeping the legs together for some time after parturition, the strictest cleanliness being enforced. But when the whole tissue of the perinæum, including the sphincter, has been lacerated, so that there is little or nothing to separate the vagina and rectum, this will probably not succeed, though even in such cases the attempt should be made. When the rupture is extensive the patient has very imperfect control over the fæces, and often can hardly walk about, from a sensation as if the uterus were coming down. Frequently there is a considerable amount of prolapsus. The operation for the restoration of the perinæum relieves the prolapsus, at any rate for a time ; and in some cases

Hypertrophy of the labia and clitoris.

Cancer of the external parts.

Accidents in parturition.

Ruptured perinæum.

of prolapsus, where the vagina is very wide, an operation exactly similar may be performed with advantage, even if there has been no rupture of the perinæum.

The operation is thus performed. The patient is narcotised, and secured in the lithotomy position; the hair is removed from the labia as far forward as is necessary; the vagina is well opened by means of a duck-bill speculum. Then two quadrangular flaps are marked out with the knife by two lines running parallel to each other along the labia, about three-quarters of an inch from the orifice of the vulva, which are joined by a transverse incision just in front of the anus. Another incision is drawn in the middle line from the centre of this last to about three-quarters of an inch inside the vagina, and from this the base of the flap extends in a slanting direction forwards and outwards to join the incision on the labium as far forwards as the surgeon thinks fit. The further forward the dissection is carried the more firm and resisting will the new perinæum be; but it is, of course, undesirable to narrow the orifice too much. After marking out the flaps, the surgeon proceeds to carefully dissect up the mucous membrane and skin from the whole of the part so marked out. On the recto-vaginal septum, if it has not been destroyed, this is facilitated by an assistant putting his forefinger in the bowel. Great care must be taken to remove every vestige of the mucous membrane. Mr. J. Hutchinson inclines to Langenbeck's practice of preserving the flaps, leaving them attached by their base in the vagina, paring them down as much as is necessary, and sewing them together in order to form a covering for the wound. I have not found much advantage from this proceeding in the cases in which I have tried it. When the denudation is complete, and the bleeding (which is often free) has been checked by torsion of the vessels and the free application of iced water, the parts are to be brought together. In cases where the recto-vaginal septum has been torn through, rectal sutures are first inserted so as to approximate the torn edges of the septum and restore the partition between the rectum and vagina. The number of sutures required will depend upon the amount of injury sustained. Fine silkworm gut is generally used for this purpose, and the sutures are to be passed close to the edges of the cleft from the vaginal to the rectal surface on both sides, so that the knots where the sutures are tied shall lie in the rectum. For this purpose it is advisable to have the gut threaded at each end with a curved needle; one needle held in a holder is then passed from above downwards close to the free edges of the mucous membrane of the cleft, and the others in the same way on the other side. When sufficient sutures have been inserted they are drawn together and tied. The raw surfaces are now to be approximated by quilled sutures. For this purpose three or four loops of strong silk or whipcord (according to the depth of the new perinæum) are passed through the whole thickness of the tissues. This is most readily effected by means of a long and very strong deeply-curved needle on a handle—called Baker Brown's needle. The point of this is entered just inside the left tuber ischii, and the ligature is carried to the very bottom of the denuded part, and the point brought out near the right tuberosity. The posterior suture should not cross the cleft at all, but should be buried in the recto-vaginal septum, when that septum exists. If such a needle is not at hand, the loops can easily be passed with a common curved needle, drawing the ligature across from one side to the other by passing one loop inside the other. There are now a series of loops on the right side of the perinæum, and a series of double ends on the other. A piece of bougie is passed through

all the loops, another is laid between the double ends, the patient's thighs are brought together, and these deep sutures are tied very firmly. The pressure on the deep parts forces the cutaneous edges in the middle outwards. These must, therefore, be attached together with silver sutures. Finally, if the vaginal flaps of mucous membrane have been preserved, they must be attached to the front of the wound. In some cases where the rectum has been much lacerated, and there is tension on the parts, it is necessary to make free lateral incisions through the sphincter on either side, sloping towards the tuberosities of the ischium; but this is not required in ordinary cases, and should always be avoided if possible. Ice may be applied in the vagina if oozing of blood occurs after the operation. Before the operation the patient should be freely purged, so that there may be no call to pass motions for some time, and artificial constipation is to be kept up for about a fortnight by the administration of about ten drops of laudanum twice a day. The water must be drawn off carefully by the surgeon or a dexterous attendant twice or three times a day, as may be necessary. On no account should the patient be allowed to pass any urine for about ten days. Then she may pass it in the prone position. She should be fed as well as her appetite permits. It is scarcely necessary to say that the period immediately succeeding menstruation should be selected; but in spite of this the operation may provoke premature recurrence of the flow, and this may prevent the healing of the wound. There is usually a great deal of foul discharge, which should be carefully syringed away with Condyl's fluid. The operation is a very successful one. In some cases fistulous openings are left in the new perinæum after union, but they can generally be easily united again. In one unfortunate case I have seen death from phlebitis and pyæmia, but such a disaster is purely exceptional. The worst which is to be apprehended is that union may not occur, and this will not generally preclude success in another attempt.

American
operation
for rup-
tured peri-
næum.

This method of operating is, as I have said, usually successful, but it is no doubt liable to the two objections raised against it by American surgeons. 1. That the approximation of the thighs tends to encourage and retain the foul discharge. 2. That the deep sutures being passed in a curved direction tend to cut their way out to the skin, and so to cause a want of union in the deep parts of the wounds, whereby a fistulous opening will be formed. To obviate this, a new procedure has been devised by Dr. Willard Parker of New York, which may be thus summarily described.¹ The sphincter ani is divided subcutaneously and then stretched. The flaps are pared off the rupture, and the edge of the recto-vaginal septum split, so that raw surfaces can be obtained without loss of substance. Then lateral incisions are made into the ischio-rectal fossa parallel to the cleft on either side, and carried into the fossa to a sufficient depth to enable the surgeon to press the deepest parts of the fissure together with his fingers passed into these cuts. Deep sutures are then carried straight across the cleft at the bottom of the incisions, and secured over pieces of elastic catheter laid in the incisions, while the edges of the cleft are united by superficial sutures both in the vagina and rectum. The flaps pared off the cleft are preserved, as in Langenbeck's method, to cover the cleft. Then the patient is arranged in bed with the thighs widely separated, and the part operated on only covered with a single thickness of

¹ See a case reported by Dr. Stimson in the 'New York Archives of Clinical Surgery,' vol. i. p. 25.

sheeting, air being freely admitted to the wound. A catheter is retained in the bladder.

As I have said above, the same operation—viz. to bring the lower part of the vagina together, so as to narrow its orifice and thicken the perinæum—is sometimes advisable in prolapsus uteri; but, as the weakness which leads to prolapsus is more in the parts above the uterus than in those below, it can only be looked on as an accessory measure. The most important part of the treatment of extreme prolapsus is rest in the horizontal position, with the uterus completely reduced. If this can be insisted on for a sufficient time, most cases of prolapsus will be found to be manageable—i.e., though not cured, the patient will be restored to fair comfort and a certain amount of activity by the use of the pessary. If the orifice of the vagina is very wide, no doubt the operation above described will assist in maintaining the position of the uterus; but, unless care is taken afterwards, the external parts will certainly yield to the pressure of the uterus, and the patient will be as bad as ever again.

An ingenious and very promising operation has recently been introduced into practice by Dr. Alexander, of Liverpool,¹ with a view of bracing up the uterus from above—viz. to cut down on the external abdominal rings and ‘wind up the slack’ of the round ligaments by cautious traction, until the position of the uterus is felt to be remedied. The ligament is then stitched to the tissues around the ring, and the loose ends attached to each other, or rolled round two pieces of wood, which are fastened together in the middle line. Four cases are referred to in which the operation was performed with success.

The stretching of the vagina in parturition or some accidental imperfection of its muscular structure may so weaken its walls that a kind of partial hernia of the bladder through them is produced. This is called ‘vaginal cystocele’—a bulging tumour in the roof of the vagina, which disappears when the catheter is used, and pressure on which may cause the escape of urine. The patient often suffers from some difficulty in making water and irritation of the bladder. The remedy consists in reducing the projecting bladder entirely, then paring a lunated edge of the vagina on each side, bringing the edges together in the median line, and keeping the bladder empty by means of the catheter retained in the urethra till the vaginal wound is soundly healed.

Vesico-vaginal and recto-vaginal fistulæ are lesions which are caused by parturition, and generally by the prolonged pressure of the foetal head, though in some cases by direct laceration, either in the passage of the foetus or by instruments.² As most of these injuries are accompanied by loss of substance, cicatrization has often taken place around the seat of perforation, and the vagina is narrowed and puckered by scars. In such cases the first step towards cure is to divide such cicatrices and keep the vagina dilated until the parts have healed. Vesico-vaginal fistula is, on the whole, easier to cure than recto-vaginal, at least in uncomplicated cases; but it is sometimes complicated with injury to the uterus or the urethra, which hardly permits of entire recovery. Thus the sloughing may have implicated the os uteri so that the

¹ ‘Med. Times and Gaz.’ April 1, 1882.

² In one very singular case, related in Dr. Emmet’s work on ‘Vesico-vaginal Fistula,’ that lesion was caused, not by any accident of parturition, but by the accidental explosion of a pistol which had fallen on the ground at the woman’s feet.

bladder and uterus form almost one cavity, or the urethra may be entirely separated from the bladder, or even altogether destroyed. In such very severe cases it may, perhaps, be better to abstain from operation altogether, and merely provide the patient with a urinal, giving her instructions to wash the parts well out with dilute mineral acid as often as is necessary to prevent the formation of sabulous concretions. In other cases an imperfect cure may be effected by uniting the back wall of the vagina to the anterior lip of the fissure, so that the uterus and bladder fall into one cavity and the patient menstruates through the urethra. I have seen cases in which this obliteration of the vagina has taken place spontaneously, so that the os uteri was completely hidden. But in the common cases in which there is no great loss of substance, and the fistula does not involve the uterus, a cure may generally be obtained, though it is often necessary to repeat the operation several times. The operation is thus performed: the patient is narcotised and placed in the lithotomy position,¹ the vagina thoroughly exposed by the duck-bill speculum, and the os uteri is gently dragged down as far as possible with a volsellum, so as to get the fistula well within reach. Then the whole of the mucous membrane of the vagina is pared away around the opening, the bladder being interfered with as little as possible, and the sutures are passed so as to take up only the tissues in the vagina and not lodge the sutures in the bladder. The object is to bring the vesical mucous membrane together as closely as possible, but not to leave any suture in the cavity which can conduct the urine into the wound. The fistula is brought together longitudinally, transversely, or obliquely, according to circumstances, so that there may be as little tension as possible on the sutures. The sutures can be secured by twisting them with the 'wire twister,' which is a stem carrying a small cross-piece of metal having a hole on each side. The ends of the wire are passed through these two holes. The suture is run up as tight as necessary, and then by rotating the handle the ends are securely twisted. This instrument enables the operator to tie the sutures at any depth where the fingers could not reach. The cleft having been completely closed, if any tension exists it may be possible to relieve it by dividing cicatricial bands in the neighbourhood, and then an S-shaped catheter of soft metal is placed in the urethra, and will keep its place by its own shape, or the catheter may be tied in: a bag is attached to it and changed as often as necessary, or the tube is left opening into a vessel below the bed. This catheter must be gently changed twice a day at first, and then every day; but the sutures need not be removed for an unlimited time. After a fortnight, if no water has passed into the vagina, the patient may be relieved from the catheter, and in another week the sutures may be examined and, if all is healed, may be gently withdrawn. If the opening is narrowed, but not closed, a few weeks must be allowed to elapse, until all irritation has subsided, before the operation is repeated.

The operation for recto-vaginal fistula is exactly the same in principle, the great object being to exclude the sutures from the rectum, so that no air or matter from the bowel may get into the vaginal wound. The bowels, as in ruptured perinæum, must be kept from action for about a fortnight, and if there is much tension on the sutures it may be necessary to divide the sphincter. Careful syringing of the vagina is very necessary to prevent the accumulation of foul discharge around the healing wound.

¹ In America the prone position on the hands and knees is often adopted, and the patient is frequently not under anæsthesia.

Operation
for vesico-
vaginal
fistula.

Operation
for recto-
vaginal
fistula.

Uterine polypi are sometimes quite small and almost sessile, growing from one of the lips, or near the cervix uteri, and consisting of the enlarged glandulæ Nabothi, or of hypertrophied mucous membrane, or cellular tissue. These tumours bear some analogy to the common mucous polypi of the nose. They never attain any large size, but may cause a good deal of inconvenience from hæmorrhage at irregular intervals, and from leucorrhœa. Their removal can never involve much difficulty or danger. The tumour, being well exposed, is to be twisted off, or, if more sessile, removed with the scissors, bleeding being repressed by the application of perchloride of iron or the cautery before the patient is allowed to recover from anæsthesia.

The ordinary polypi, however, consist of fibrous tissue mixed with unstriped muscle. They grow from the muscular wall of the uterus, and often attain an enormous size. When they pass into the cavity, so as to assume the form of polypi, they usually become detached from the muscular tissue

Polypus
uteri.



FIG. 398. Polypus of the uterus. From a preparation in the Museum of St. George's Hospital. The tumour is seen to spring entirely from the anterior lip of the os, and could have been easily removed. The woman died, under ether, just before the commencement of the operation. (See 'Brit. Med. Journ.' May 15, 1884.) *a* points to the opening of the os uteri. *b*, to a small embedded fibrous tumour.

of the uterus, and are completely covered with mucous membrane, though this is not always the case. Though they may cause very great hæmorrhage, they are not usually in themselves very vascular. They are peculiarly prone to calcareous degeneration, and preparations exist showing such tumours converted almost entirely into an earthy mass covered by the mucous membrane.

There are, again, other polypi much looser and more vascular than these, which are sarcomatous in structure, and prone to obstinate recurrence after removal; and malignant disease will sometimes grow in a pendulous form like polypus; but both these events are rare.

The general subject of fibrous or fibro-muscular tumour and polypus of the uterus belongs more to obstetrics than to surgery; but a few words must be said about the removal of these tumours. Polypi, i.e. the pendulous tumours attached to the interior of the uterus, may be removed with ease when their attachment can be exposed, and this is usually near the os uteri.

And, even if the surgeon cannot penetrate to the seat of implantation of the polypus, he may be sure that any small remnant of the neck of the polypus which he may have been obliged to leave will wither away. Small polypi, or those whose neck is thin, may be safely removed by torsion. The patient is to be narcotised, and the polypus, being well exposed, is to be grasped near its root with a volsellum forceps, and slowly twisted round till it is loose. If the neck is so thick that this would not be expedient, the wire *écraseur*¹ may be used to divide the neck, or the galvanic *écraseur* may be used with still less risk of hæmorrhage or of unhealthy inflammation.

Enuclea-
tion of
fibrous
tumour.

Embedded fibrous tumours may be removed by enucleation, but, as this is a very dangerous and uncertain operation, it should never be attempted unless the tumour is presenting at and has distended the os. The old operation of dilating the os with tents, and seeking a fibroid in the uterine cavity, and then cutting through the capsule and shelling out the tumour, is not to be recommended, and other means must be adopted for its relief: either oöphorectomy, to check hæmorrhage and possibly arrest the growth of the tumour, or extirpation by abdominal section. When, however, the tumour protrudes through the os, its capsule may be divided by the knife, and then the tissue of the tumour must be separated from that of the uterus with the finger, or any convenient blunt instrument, sufficiently to allow of the implantation of a strong pair of volsellum forceps in its substance. Then the tumour is to be gradually dragged outwards, care being taken not to invert the uterus until the fibroid has been completely enucleated. The cavity is then to be plugged with a sponge or pledgets of wool soaked in tincture of iodine, and the vagina must be frequently syringed out with antiseptic solutions.

Hysterec-
tomy.

Again, fibrous tumours of the uterus may grow upwards towards the peritoneal cavity, and these sometimes soften and simulate ovarian tumours, as will be afterwards pointed out. In other cases, without any softening, the growth proceeds to such an extent as to become dangerous to life from its pressure, or to render it impossible for the patient to perform any of the ordinary duties of life. Under such circumstances the operation of removing the tumour together with a portion or the whole uterus, or even the ovaries also, has been often performed, and with a great amount of success, though I need not say that the gravest consideration of the symptoms, and of the probable danger of leaving the case to itself, is necessary before so very dangerous an operation is undertaken. In the only case in which I have myself operated the operation was undertaken in the mistaken belief that the tumour was ovarian, and it proved immediately fatal.

The operation resembles ovariectomy in its early steps. The tumour, having been completely exposed and freed from adhesions, if it has any, is to be tapped, if it has softened in any part, in order to facilitate its extraction, or, if lobulated, portions may be removed with the *écraseur* to diminish its bulk. When the tumour is fairly exposed the further treatment must depend upon the connections of the tumour. If the growth consists of that variety which is known pathologically as a pedunculated subperitoneal fibroid, the pedicle may be transfixed by a stout silk ligature and then tied and the tumour removed; the cut edges of its peritoneal investment being sutured over the surface of the stump. When, however, the pedicle is too

¹ This is an *écraseur* in which the chain shown in Fig. 301, p. 657, is replaced by a noose of stout wire; in using this, or the galvanic *écraseur*, it is essential to divide the tissues very slowly.

thick to admit of this treatment, or when the growth closely involves the uterus, 'supra-vaginal hysterectomy' must be had recourse to. The tumour having been turned out of the abdominal incision, the lower part of the uterus or upper part of the cervix is to be encircled with a wire loop, which is then to be connected with a small *écraseur*, known as Koeberlé's *serre-nœud*. In passing the loop, care should be taken, if possible, to include the Fallopian tubes, the ovaries, and the greater part of the broad ligaments. Sometimes, however, these appendages lie too low to allow of this kind of treatment, and they must then be dealt with as in oöphorectomy. Before the wire is tightened it must be carefully examined to ascertain that it does not include the fundus of the bladder or a loop of small intestine. After having been accurately adjusted the wire is tightened by means of the screw of the *serre-nœud*, sufficiently to constrict the blood-vessels, but not cut through the tissues. One or more pins are then inserted through the pedicle at right angles to the abdominal wound, on the distal or uterine side of the wire, in order to support the stump outside the wound, and the tumour is cut away. After this the abdominal incision is carefully closed around the stump, the pin or pins resting on the abdominal wall and maintaining the remains of the pedicle in position. The stump is dusted with iodoform and the dressings applied.

The growth of uterine tumours is often suspended by the cessation of ovarian activity, and from the observation of this fact it has been proposed to remove the ovaries in cases in which the patient is suffering severely from the symptoms of fibroid tumours of the uterus, which it seems too dangerous to excise. The ovaries have also been removed for the cure of neuralgia, menstrual irregularities, and aggravated hysteria. The operation is called oöphorectomy, or Battey's operation. The ovaries may be removed by an incision through the vagina, or, as is more common in this country, by cutting into the peritoneum in the median line, as in ovariectomy. The pedicles are tied with carbolised silk or gut, and dropped back into the abdomen.

Oöphorectomy.

Cancer of the uterus commences generally at the os, and in some cases it is detected at a period when it has not spread too far for removal. In such cases much benefit has, no doubt, sometimes been produced by the excision of the diseased structures. The operation is, however, a dangerous one, and in most cases the relief is only temporary. Still, if the surgeon can be sure of the diagnosis,¹ if the disease has not spread to the vagina, and if the general health is still good, it is his duty to make the attempt.

Excision of os uteri for cancer.

The disease may be removed either by total extirpation of the uterus, or by supra-vaginal amputation of the cervix, or by amputation of the vaginal portion of the cervix only.

Total extirpation is required only in those cases where the malignant disease has extended high up the cervical canal, and where, at the same time, the mobility of the uterus is unimpaired and no cancerous infiltration of the connective tissue around the cervix has taken place.

The whole of the uterus may be removed through the vagina by cutting through the vaginal mucous membrane along its reflexion on to the cervix

¹ Mr. Hutchinson says: 'It is not by any means an easy matter in many cases to make a confident differential diagnosis between a simple or venereal ulceration of the os uteri and one of a malignant nature in an early stage. The tendency of the latter to bleed, its warty and thickened edges and fœtid discharge, are the chief symptoms on which to rely. The surgeon must notice especially whether there be any tendency to new growth, and, if practicable, a small portion of the edge should be removed for microscopic examination. Pain, if severe, is a very suspicious sign.'

by means of scissors, by separating the uterus from its cellular connections with the bladder, and dividing the reflexion of peritoneum from the uterus on to the bladder in front and Douglas's pouch behind. By doing this the uterus is freed from all its connections, except the broad ligaments laterally, and can be pulled down so that the broad ligaments can be got at and secured. This is to be done by transfixing them with a ligature, external to the ovary and tube if possible, tying the ligament in two pieces, and dividing it between the ligature and the uterus.

Supra-vaginal amputation of the cervix is performed very much in the same way as total extirpation, as regards the earlier steps of the operation. That is to say, the reflexion of the vaginal mucous membrane is divided, and the cervix is separated from its connections to the bladder, but the peritoneum is not to be opened. A wedge-shaped portion of the uterus, including the whole of the cervix, is removed, and the cut surfaces of the stump united to the anterior and posterior vaginal wall to prevent retraction.

The vaginal portion of the cervix may also be removed by the galvano-cautery, by the *écraseur*, or by knife and scissors. Of these methods, probably the galvano-cautery is the best, since, if Douglas's pouch should be accidentally opened, serious results are less likely to follow than with other modes of performing the operation. The severed edges of the peritoneum become glued together by the hot wire, and no ill effects follow. In performing the operation the cervix is to be seized with a volsellum and dragged down. A loop of platinum wire is made to encircle it above the diseased portion of the cervix, care being taken to avoid Douglas's pouch behind and the bladder in front. When the wire is adjusted the current is applied and the wire kept, as far as possible, at a dull red heat, so as to cut slowly through the tissues.

The ovary is liable to tumours of all kinds. The solid tumours are fibroma, sarcoma, and carcinoma. The fibroid tumours are difficult of diagnosis from similar tumours of the uterus, which are sometimes pedunculated and attain a very large size. The fibroid tumours also are at first difficult to distinguish from the cancerous, but the different rate of growth will settle the question ultimately. No surgical interference is advisable in solid tumours of the ovary. Those which are innocent will probably cease to grow, and the patient will ultimately become accustomed to their presence, while in malignant disease an operation would do nothing but harm.

But the ovarian tumours with which surgeons are most concerned are cystic. These cysts are multilocular; dermoid and papillomatous cysts, connected with the ovary; and simple cysts or parovarian cysts, connected with the broad ligaments. The multilocular cystic tumour of the ovary, common ovarian tumour, is by far the most common. The tumour consists of a number of cysts of very various sizes, one or two of them generally predominating, and forming cavities sometimes of enormous size, around which are clustered many smaller cysts, which give to the surface of the tumour an irregular lobulated appearance. A large number of these tumours contain solid growths in the interior of the cysts, and are then termed proliferous. These solid masses are made up of minute loculi, lined with columnar epithelium and containing a thick glairy fluid. They are therefore classed as glandular or adenomatous growths. The character of the fluid contained in the multilocular cystic tumours varies greatly. It is almost always less serous than the fluid of peritoneal dropsy, and is very commonly thick and gelatinous, like thick gum. In colour it is usually yellow or greyish;

Ovarian
tumours.

Cystic
tumours.

but often, if hæmorrhage has taken place into the cysts, it is very deep in colour. It is rich in albumen, often contains a good deal of cholesterine, and is of a high specific gravity. Sometimes it is sero-purulent and occasionally is unmixed pus.¹ The precise mode of origin of the cysts of which these tumours are composed is still a matter of some doubt. The most probable explanation is that advocated by Mr. Doran: 'The most probable origin of cystic disease of the ovary is an arrest of the normal retrograde metamorphosis of Graafian follicles that have never become corpora lutea of menstruation or pregnancy.'² Dermoid cysts are generally multilocular, but contain fewer loculi than the preceding, and rarely attain a large size. The cysts are lined with dense layers of squamous epithelium and contain a semi-fluid material, sometimes resembling sebaceous matter, sometimes oily in consistence, and sometimes, when mixed with blood, consisting of a brownish or chocolate-

coloured paste. They also contain hair, bone, teeth, and cholesterine. Their mode of origin is uncertain.

The papillomatous cystic tumour of the ovary arises from the tissue of the hilum and not from the parenchyma. They are almost unilocular, and their chief characteristic, from which they derive their name, is that the cysts contain a cauliflower growth, consisting of papillæ, covered with cylindrical epithelium. This is sometimes abundant and sometimes scanty. The fluid in these cysts differs from that in the ordinary ovarian tumours, which also occasionally contain papillomatous growths, in that it is thin, clear, and watery, of low specific gravity, and free from albumen and organic products. They are supposed to originate from the remains of the

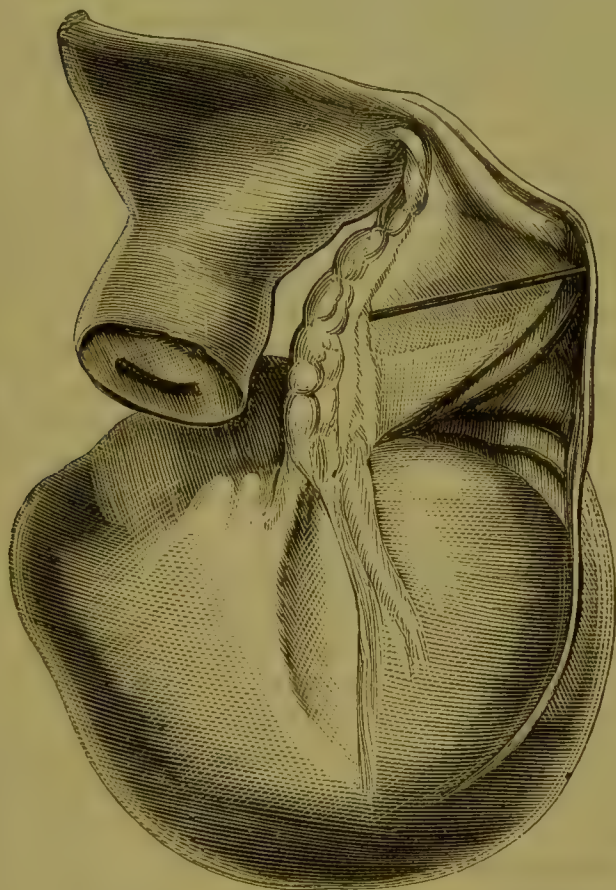


FIG. 399. A watery cyst in the broad ligament of the uterus, which is perfectly separate both from that viscus and from the ovary. The ovary and its ligament are seen lying over the tumour on the side next the uterus, and the Fallopian tube stretched over it on the other side. The ovary is perfectly normal.—St. George's Hospital Museum, Ser. xiv. No. 131.

Wolffian body, traces of which are to be found in the hilum of the ovary.

Simple cysts of the broad ligament are almost always unilocular. They consist of a thin-walled cyst lying between the layers of the broad ligament, and containing a clear, watery, non-albuminous fluid, of low specific gravity.

¹ I would refer the reader to the lectures of Sir Spencer Wells at the College of Surgeons for the chemical and microscopical characters of ovarian fluid.—See 'Brit. Med. Journ.' June 15 and 22, 1878.

² 'Clinical and Pathological Observations on Tumours of the Ovary, Fallopian Tube, and Broad Ligament,' 1884.

Some of these are said to arise from the organ of Rosenmüller or parovarium, and to contain papillary growths. They are then named 'parovarian cysts.' These cysts of the broad ligament seldom attain a size large enough to call for surgical operation, though one containing eighteen pints was successfully removed by Mr. Cæsar Hawkins and is preserved in the museum of St. George's Hospital.

The gradual growth of an ovarian cyst produces what is called ovarian dropsy, i.e. a distension of the belly with a very large quantity of fluid, which occasions much the same symptoms as peritoneal dropsy, viz. shortness of breath, inability to take exercise, œdema of the lower limbs from pressure on the large veins, and sometimes pressure on the bladder, causing irritation, or in rare cases difficulty in making water.

Termina-
tions of
ovarian
dropsy.

If the disease is allowed to run its natural course it may prove fatal from the effects of its pressure, causing difficulty in taking food, and wasting in consequence of the loss of albuminous material into the cyst; or it may burst into the peritoneal cavity, and then usually causes death, though a few instances have been recorded in which the fluid was absorbed again from the peritoneum; and it is even possible that spontaneous cure may thus take place. In rarer cases the tumour may ulcerate into the bowel, bladder, or vagina, and this also is almost sure to produce death. In some rare cases, as it seems, the tumour may cease to secrete, and the fluid even may be to a certain extent reabsorbed. The suppuration of the tumour will probably lead to its ulceration, and this must almost necessarily be fatal.

Thus we see that the progress of ovarian dropsy is, speaking generally, to death, though its rate of progress varies greatly.

Diagnosis.

The diagnosis of ovarian dropsy is not by any means easy in all cases, as is seen by the mistakes which are known to occur in the practice of even experienced ovariologists. The first question is as to peritoneal dropsy. Peritoneal dropsy depends on disease of the kidneys, heart, or liver, so that it is necessary, in first taking charge of a case of supposed ovarian tumour, to ascertain that these viscera are healthy.¹ Then the physical examination of the abdomen differs in peritoneal and ovarian dropsy. In the former the whole abdomen is uniformly dull, unless the abdomen is so little distended that the transverse colon floats to the surface and its resonance is perceptible. In the latter the transverse colon is quite buried, but the flanks are resonant, and the line of the cyst can often be traced by making the patient turn from side to side, and observing how the resonance to percussion advances or recedes. The tumour can also in many cases be felt in the pelvis by examination from the vagina or from the rectum; and very frequently the surrounding cysts can be felt as hard masses in the wall of the principal tumour. In cases of doubt decisive information may, very likely, be obtained by tapping, for the appearance of the dense, sticky, gum-like, and often deeply-coloured fluid which is often found in ovarian cysts is quite different from the greenish serum of dropsy.

Another source of error is mistaking a softened fibroid tumour of the uterus for an ovarian cyst. In a case of this kind which happened to myself as much as a gallon of fluid was contained in the softened fibroid, and the mobility and relations of the tumour exactly resembled one of the ovary. But if an accurate history can be obtained it will be found that there has

¹ It is true that disease of these viscera does not necessarily preclude the occurrence of ovarian dropsy, but it would at any rate in most cases contra-indicate any attempt at removal of the ovary.

been flooding, the uterine sound will probably discover that the cavity of the uterus is elongated, and the tumour is not fluid, but semi-fluid, so that, though a good deal of fluid can be obtained from it by tapping, it does not run out freely as from a cyst.

Large cysts are also found in the kidney, and these have been operated upon by mistake for ovarian dropsy. Such tumours, however, generally present more towards one flank than ovarian tumours do, their contents are more or less urinous, and if the hand can be got into the rectum (page 678) the difference in their relations may probably be perceived.

Pregnancy has been mistaken for ovarian dropsy, but in most cases from haste or carelessness. Whenever the patient is of child-bearing age the possibility of pregnancy should not be overlooked, and careful examination should be made for its usual signs. It is more common and less discreditable to overlook pregnancy when it complicates ovarian dropsy; but even in cases of decided ovarian tumour, if the patient is married or is likely to be pregnant—i.e. if the menses have not appeared for some time—the breasts should be inspected, the abdomen carefully auscultated, the os uteri examined, and ‘ballottement’ searched for.

Lastly, tumours of various kinds, chiefly those in the omentum, and even phantom tumours, have been mistaken for ovarian cysts; but a careful surgical examination will prevent any such error. Phantom tumours very commonly disappear under anæsthesia.

When the diagnosis is settled the question of treatment occurs. There is in the present day for ordinary cases of ovarian tumour but one method of treatment, and that is by excision, and the operation of ovariectomy should, in the majority of cases, be performed as soon as the ovarian tumour is diagnosed. It is true that tapping was formerly recommended largely as a palliative measure, and in a few instances has been known to result in cure. These were probably cases of simple cysts of the broad ligament, but, as these cysts cannot be diagnosed from the parovarian cysts which contain papillary growths, most surgeons are inclined to recommend ovariectomy rather than tapping, even in a tumour supposed to be connected with the broad ligament, since this operation, slight as it is, is not without its special risks and may very likely be followed by adhesions, which will present a serious obstacle to any future operation. In all other cases of ovarian disease tapping can only be a palliative measure of the most temporary character. The fluid is seen to re-accumulate again, sometimes with enormous rapidity, and necessitate a more and more frequent repetition of the tapping, which speedily exhausts the patient. Neither infancy nor old age is a barrier to the operation. Ovarian cysts are sometimes detected in early life; the dermal tumours are probably always congenital, though they do not usually show till later in life; and other cysts may be developed in childhood. It would be impossible to expect prolonged life in such cases except after ovariectomy. In old age also the operation is not only justifiable, but called for, so long as no independent organic disease exists, which in all probability would in itself cause a speedy death, or the patient does not present an appearance of marked decrepitude. Ovarian disease, however, is rarely found occurring late in life. Even pregnancy is no bar to the operation. Formerly it was the custom, when a patient suffering from ovarian tumour was discovered to be pregnant also, to induce premature labour, but in recent years the operation of ovariectomy has been performed on pregnant women in very many instances, and without causing abortion. It is best, if possible,

Treatment.

to operate before the fourth month, since after this the structures forming the pedicle become turgid with blood, which may interfere with the performance of the operation, and may prove serious if there are any adhesions requiring rupture, from the amount of hæmorrhage.

Ovariotomy.

Ovariotomy is thus performed. The patient should have been well purged, and should have her legs covered with a pair of warm drawers. The room should be warm—nearly 70°. A large band is to be passed round the belly, of waterproof cloth, with a hiatus for the incision. She should be in the recumbent position on a firm table. The bladder should be empty. Full anæsthesia having been produced by ether,¹ an incision is made in the linea alba from a little below the umbilicus to a little above the pubes, and this is deepened by successive strokes of the knife till the peritoneum is exposed. The peritoneum having been opened, some ascitic fluid very commonly escapes. The surgeon introduces his fore and middle fingers, and sweeps them round over the cyst to ascertain in the first place that he is really in the peritoneal cavity, and secondly to feel for adhesions.² These, if present, are gently separated from the wall of the cyst, until the whole hand is introduced, and the cyst is freed from adhesions on all sides. Now the trocar is plunged into the cyst. To the trocar a tube is fixed which goes into a pail on the floor. As the cyst is punctured the surgeon seizes it with a volsellum and draws it forward, so as to keep the trocar opening as much as possible outside of the wound in the belly, and he and his assistants take care that the trocar does not slip. Sir Spencer Wells has introduced a trocar the end of which is hollow and can be retracted within the cannula, and which has a set of hooks on each side. As the cyst-wall collapses with the escape of the fluid it is drawn into the grasp of the hooks, and thus the cannula is firmly fixed. I have used this trocar with good results; but if the cyst-wall is thin the hooks are liable to tear it, and then it is better to trust to gentle traction with blunt forceps. As the fluid escapes and the cyst collapses the surgeon passes his hand gently round the sides and top of the tumour to ascertain that there are no adhesions behind, to divide them carefully if there are, and to deliver the cyst. And at this stage of the operation the operator may find reason to extend his incision upwards even as high as the ensiform cartilage.³ At the same time the assistants (one on each side) keep up guarded pressure on either side of the abdomen, so that the intestines may not protrude. When the first cyst has been emptied it may be necessary to puncture others in the same way before the tumour can be delivered, and in doing so the escape of

¹ Sir Spencer Wells uses the bichloride of methylene; but ether seems to have all the necessary properties, being little liable to cause sickness and not producing depression, whilst it is by most surgeons regarded as safer than methylene.

² I know of no way of determining the presence or absence of adhesions in most cases. Sometimes they may be detected by a certain crackling of fluid in them, and may often be suspected from the history of previous pain or other symptoms of peritonitis. But in all old-standing cases they may be expected. Their existence to a moderate extent does not seem to prejudice the patient's prospect. Sir Spencer Wells is in favour of opening and emptying the principal cyst before making any attempt to separate the adhesions, believing that thus there is less risk of mistaking the peritoneum for the cyst-wall. Other operators are in favour of separating the adhesions in front before opening the cyst. Doubtless either the one or the other course has its advantages in appropriate cases.

³ It is well not to make the incision longer than necessary. It is true that it is far better to make any necessary length of incision than try to remove a large tumour through too small an opening—but Sir S. Wells shows that when the mass can be removed through an incision only 5 or 6 inches long the mortality is considerably less than when the wound extends to 9, 10, or 11 inches.

cyst-fluid into the peritoneal cavity is still more probable. Or the tumour may be adherent to the liver or omentum above, to the intestines behind, or to the wall of the abdomen or pelvis. These posterior adhesions are the most formidable complication in ovariectomy, especially those to the intestine. The omentum contains large vessels, and it may be necessary to tie it with catgut before freeing it from the tumour; otherwise there is little trouble in dealing with omental adhesions. Adhesions to solid viscera are not generally very formidable, but the intestine is sometimes almost imbedded in the wall of the tumour. In such a case the peritoneal lining of the tumour must be slowly and carefully peeled off along with the bowel. Clamps of various forms should be at hand, so that any broad band of adhesion may be securely clamped while it is divided and its vessels tied with catgut. This appears preferable to searing the bleeding surface with the actual cautery, though the latter is a plan adopted with success. Finally, the tumour having been freed and its remains delivered through the wound, its pedicle must be secured. Three ways are in use for this purpose, viz. to fix a clamp on the pedicle, outside the wound; to divide the pedicle with an *écraseur*, cauterise it if necessary, and drop it back into the pelvis; or to tie the pedicle with carbolised silk, cut the ligature short, and remove the tumour. The use of the clamp was at one time almost universal, but it is now, I believe, entirely given up; nor do I know that any one, at least in this country, employs the *écraseur*. The intraperitoneal ligature of the pedicle has not only been found to be perfectly safe, but there seems no question that the great diminution in the mortality after ovariectomy in recent times is to be ascribed in very great part to this change in treatment. The tumour having been removed, the surgeon passes down his finger to the other ovary to assure himself that it is healthy. If so, the wound is united after any cyst-fluid which has got into the pelvis has been gently removed with a perfectly clean new sponge. In uniting the wound stout gilt harelip needles used to be much used. These are passed from the left to the right lip of the wound, about an inch from its edge, and embrace the whole tissue down to the peritoneum; and it is necessary that the pin should take up a small piece of the peritoneum on either side (p. 227). Sir Spencer Wells, however, prefers sutures of pure silk, each piece of silk being threaded on two needles which are passed in from the peritoneal edges on either side of the wound to the skin. This way of passing the sutures has the advantage that the edges of the wound can be so drawn up with the sutures which have been already passed, that in placing the later ones the surgeon cannot wound the bowels or other viscera—an accident which is known to have taken place with the harelip suture. The wound is then dressed, and a broad flannel roller applied, and the patient cleaned from any stains of the operation and put into a warmed bed. About $\frac{1}{4}$ of a grain of morphia should be injected subcutaneously, or double the quantity introduced as a suppository.

In cases where there is 'a great probability of blood, serum, or pus collecting in such quantity as to require removal,' Sir Spencer Wells is in favour of drainage of the peritoneal cavity by a glass tube passed behind the uterus to the bottom of Douglas's pouch, and secured in the wound, through which the peritoneal fluid can be removed with a syringe, or antiseptic injections practised ('Med.-Chir. Trans.' vol. lx.).

The after-treatment of the case should be simple. For about twelve hours nothing should be given by the mouth. The patient, if restless, should be quieted by subcutaneous injections or suppositories of morphia, some pieces of

ice should be given to suck, and she may, if much exhausted, require stimulant enemata; but as a general rule the less that is given in any way at first the better. The room should be kept warm but fresh, and the pulse and temperature carefully watched; and as soon as the tendency to vomiting has passed away, nourishment and stimulants should be given as the state of the pulse indicates. The urine must be evacuated with the catheter for several days at any rate after the operation. The wound must be treated on general principles. In favourable cases it will not want touching for about eight days, when it will be found completely united.

Acute and general peritonitis is almost always rapidly fatal. Its treatment must be the same as after herniotomy. Limited inflammation and suppuration sometimes occurs around the pedicle, and by no means precludes the hope of a successful issue, though it will retard union.

Results of
ovario-
tomy.

No operation has been more conspicuously, and I may say more wonderfully, improved in its results by the modern methods of treatment than ovariectomy. Introduced into general practice at a time which is still very recent, it was at first vehemently denounced (and that by some of the best and most experienced surgeons and obstetricians of the day) on account of its hopeless character and excessive mortality. It is now practised with a success far above that of most of the capital operations, as far as its immediate mortality goes, and has the great additional advantage that it leaves the patient unmutated and unimpaired in function or constitution, with the normal expectation of life; and, if one ovary only has been removed, apparently as fertile as before. This improvement in the results of the operation has been gradual, as may be seen from the interesting paper ('Med.-Chir. Trans.' vol. lxiv.) in which Sir Spencer Wells sums up the results of 1,000 cases of ovariectomy in his own practice from 1859 to 1880. 'The number of deaths in each series of 100 cases, from 34 in the first 100 and 28 in the second, was 23, 22, 20, 28, 24, 17, and 11.' This progressive diminution was due in part, no doubt, to increased familiarity with the operation, and in great part to the intraperitoneal method of securing the pedicle, which has now become the rule both with Sir S. Wells and all other operators; but in great part also to that minute attention to scrupulous cleanliness which constitutes the antiseptic method. In fact, Sir S. Wells, while allowing the great effect which the intraperitoneal method has had in reducing the mortality, says that the success of this method is only possible provided that putrefactive changes can with certainty be avoided in and about the tied pedicle; and so far as this goes all surgeons are agreed. Whether the special precautions which are comprised under the term 'Listerism' be or be not advisable, is, however, a question by no means settled, and especially as to the use of the spray. In the volume of the 'Med.-Chir. Trans.' above referred to (vol. lxiv.) are two papers by experienced ovariectomists, Dr. Bantock and Mr. Knowsley Thornton, the former of whom rejects the carbolic spray and all the other special details of Lister's method, trusting merely to the most scrupulous cleanliness; while the latter is an ardent follower of Mr. Lister. Mr. Knowsley Thornton uses all the Listerian precautions, and claims a mortality of four per cent. Mr. Lawson Tait ('Med.-Chir. Trans.' lxiii. p. 161) rejects them all, and claims the same success. Mr. Lawson Tait agrees with Dr. Bantock in thinking that the carbolised spray is deleterious, and in fact it is now seldom used. At St. George's Hospital a spray of sulphurous acid was at first substituted for it; but now cases seem to do equally well without any spray at all. But the precautions against any

Antiseptic
ovario-
tomy.

accidental impurity being brought into contact with the peritoneum, or any putrefying or putrescible matter being left in the peritoneal cavity, must be very thorough. The incision is to be made slowly, and all bleeding vessels to be commanded, either with clamp or carbolic ligature at once, so that no blood runs into the deeper parts. In dividing adhesions similar precautions are to be taken. All the instruments and sponges are to be carefully cleaned and then soaked for a proper time in carbolic lotion before use. A sponge should not be used twice on the same day, and every instrument is to be immediately replaced in the lotion. The operator should frequently clean his hands, so as to avoid as far as possible inoculating the parts exposed with any blood or fragments of decomposable matter; and if any cyst-fluid or blood has got into the peritoneal cavity, it should be carefully removed before the wound is sewed up. Whether the dressing should be 'antiseptic' in Lister's sense, i.e. containing carbolic acid or other volatile antiseptic for the destruction of the germs in the air which reaches the wound, is another moot point. Several operators claim as much success with ordinary dry dressings as others do with carbolic and other antiseptic gauze. The wound is united throughout, no drainage being ever thought necessary, except in some rare cases of tendency to oozing of blood, or in cases where some adherent portion of the cyst is necessarily left behind. No second dressing will be required usually till about the eighth day, when the wound will be found united and the patient practically well. In such cases, which are now becoming the rule instead of the exception, there is very little and sometimes no fever, nor any necessity for special treatment.

Another gratifying feature in this improvement in our experience of ovariectomy is that the operation is performed in general hospitals and by the ordinary surgeons of those hospitals with perfect success, and that no special institutions or special operators are required. The patient merely wants a room and a nurse to herself, and to be attended by persons who know how to take the proper precautions and are careful to do so.

I have spoken of cases of ordinary ovarian tumour in which the surgeon believes the disease to be of a non-malignant nature. When the rapid growth of the mass and the constitutional condition of the patient excite a suspicion of cancer, it is, as a general rule, advisable to abstain from operating. Yet Sir Spencer Wells has shown¹ that in some cases where the growth seemed undoubtedly malignant, the operation has succeeded, and the patient been, at any rate for 10 or 11 years, free from any return.

Malignant
ovarian
tumours.

The more strictly obstetric operations, viz. the Cæsarian section and those for extra-uterine pregnancy, are not treated of in this work.

¹ 'Brit. Med. Journ.' 1878, vol. i. p. 927.

CHAPTER XL.

DISEASES OF THE BREAST.

Hypertrophy.

THE female breast is occasionally affected with simple hypertrophy. It is a rare disease which commences generally soon after puberty, in single women as well as married. It is distinguished from tumour of the breast partly by its perfectly even and homogeneous feel, partly by the absence of all symptoms, and partly by the fact that it usually affects both breasts, which tumours hardly ever do. The diagnosis is generally obvious if careful examination be made. In some cases large tumours of the breast have been carelessly classified as 'hypertrophy'; but the error is one easily avoided. Nor should the genuine hypertrophy be confounded with the temporary enlargement which sometimes accompanies amenorrhœa. The differences are well described by Mr. Birkett.

When the breasts are seen to be enlarging gradually, and to an inconvenient extent, the surgeon's first care is to inquire into the general health, and to attempt to stop the progress of the affection by correcting anything that may be amiss. Carefully applied pressure may also be tried. But it must be allowed that little good is usually done by any measure short of amputation, and to this no surgeon would willingly resort unless it is absolutely necessary in order to allow the patient to go about. It is said that sometimes after the removal of one breast, the other has become smaller.

Atrophy.

Atrophy of the breast is natural in the later period of life, though usually it is not much noticed, as the place of the gland-tissue is occupied by fat; but atrophy also takes place sometimes without any known cause, or in connection with the growth of a tumour in some part of the breast, or from excessive lactation. But it must be remembered that a good deal of wasting of the breast is quite consistent with the perfect integrity of the gland-tissue as evidenced by the secretion; and it is noticed that women with breasts which are very small, and have been supposed to be atrophied, often have a fuller supply of milk than others. Sometimes, however, there is a general atrophy, with consequent want of milk. Nothing can be done to avert it.

Inflammation.

Inflammation of the rudimentary breast in infancy is not uncommon in both sexes, perhaps more so in boys than girls. It produces redness and tenderness, with a serous or even milky secretion from the nipple. Nurses are in the habit of aggravating the mischief by rubbing, to 'rub away the milk,' as they phrase it. This ought never to be permitted; the irritation will soon subside under soothing lotions and cataplasms, with attention to the state of the bowels.

Inflammation also occurs sometimes at puberty, and here also in the male as well as the female; though in boys it is usually insignificant and transient. Among females, it commonly occurs in girls of a weak constitution, or in those whose general health is below par from overwork or from some unassignable cause. It sometimes lays the foundation of chronic or cold abscess.

Acute inflammation during pregnancy and lactation.

The common cause of inflammation of the breast is irritation in suckling. It especially occurs in cases where the ducts become over-distended and irritated, when the breasts cannot be regularly and completely emptied. Its cause is therefore often to be found in an imperfect development of the nipple, so that the child irritates it by constantly tugging at it without succeeding in producing a free vent for the milk. It generally, under these circumstances, occurs within a month after delivery, and usually in primiparæ. But the inflammation sometimes commences with the secretion of the milk, or even before this, with the vascular excitement preliminary to the secretion, especially if the breast has been irritated or injured.

The first symptoms complained of are generally a little weight and soreness about the lower part of the breast, especially whilst the child is being suckled. At the same time there is a feeling of *malaise* and chilliness, even in some cases amounting to a rigor. Upon examining the breast an indurated patch, which is tender on pressure, will generally be found at the lower and outer part of the gland. The patient now becomes feverish, the temperature rises, the pulse is quick, and the tongue furred; thirst and headache are complained of; the swelling in the breast increases, and several patches of ill-defined hardness may be felt; the skin over the indurated part becomes œdematous and reddened, and there is acute pain and tenderness on pressure. Under the influence of treatment the inflammation may be arrested without suppuration, when it leaves more or less induration, which may persist for months; but in the majority of cases it runs on to suppuration, and acute abscess of the breast results.

The treatment of this condition must be in the first instance directed to the prevention of suppuration. And to attain this both physiological and mechanical rest to the inflamed organ must be given. The child should be at once weaned. It is not sufficient to withdraw the infant from the affected organ and allow the mother to continue suckling it with the other breast, for the act of suckling with the one gland keeps up a condition of activity in the other. The milk must be gently drawn with a breast-pump at regular intervals. The breast must be carefully slung by a soft silk handkerchief carried under the inflamed organ and tied over the opposite shoulder, and the arm should be fixed to the side.

As regards local applications, nothing seems to answer so well as painting the whole inflamed surface with a mixture of equal parts of extract of belladonna and glycerine and then applying fomentations. Leeches are sometimes recommended; but, except in the case of a plethoric and robust young woman, in which class, however, this disease rarely occurs, they are of little use; and the same may be said of the application of cold, which has been largely employed in America. The patient should be kept as much as possible in the recumbent position, a light, nutritious, easily digested diet with tonics should be ordered, and the bowels kept gently relaxed with an occasional saline purgative.

If in spite of this treatment the case goes on to suppuration, the pain in the breast increases and becomes of a throbbing character, and there is much heat and tension of the part. The temperature rises still higher, to 103° F. or more, and possibly there may be a second rigor. The indurated swelling speedily softens in its centre, and fluctuation is soon to be perceived. As soon as this is felt, an incision should be made, radiating from the nipple, and a drainage tube inserted. The evacuation of the matter gives great relief and prevents the abscess from burrowing about in the gland or behind it. Cases

Mammary abscess.

in which incisions have been neglected or refused are often seen, in which the breast is riddled with sinuses, indurated in various parts, and probably permanently damaged as a secreting organ. Patients with abscess after lactation require good diet; full doses of quinine are often very beneficial, and a moderate allowance of wine or porter, care being taken not to overload the digestive organs. In addition to the true mammary or intra-glandular abscess, suppuration may take place either in the subcutaneous tissues superficial to the breast, or in the connective tissue between the mamma and the great pectoral muscle, constituting the post-mammary abscess. The former of these conditions is usually of comparatively trifling importance. There is a little swelling and induration of the superficial structures, which speedily softens and suppurates, and fluctuation is perceived. The abscess is opened and drained, and rapidly heals up without difficulty. The post-mammary abscess, on the other hand, is a condition of considerable importance. It is supposed to arise from suppuration taking place in a deep lobule of the gland, and from thence spreading to the connective tissue between it and the muscles of the front of the chest. The matter forming in this situation pushes the breast forward and spreads beneath it and points at its circumference.

The symptoms in the early stage are very similar to those of mammary abscess itself; but it will be noticed that the breast is pushed forwards, and presents a uniformly smooth and tense conical appearance, without being indurated in one part. Great pain will be complained of on moving it over the pectoralis major muscle, or on moving the arm from the side. At first there is no redness or œdema of the skin; but after a time redness, followed by evidence of fluid, appears at the circumference of the breast, generally at its lower and outer margin. Occasionally abscess may form at several points around the breast.

In the treatment of this condition, as soon as it is evident that matter has formed, the patient should be brought under anæsthesia, and an incision made under the breast into the collection of matter, so as to afford a depending opening, which is to be kept patent by a large drainage tube. The troublesome sinuses which frequently result are generally due either to want of thoroughly opening up the cavity of the abscess or to neglect of efficient drainage.

In cases where these sinuses form, they should be laid freely open, scraped with a sharp spoon, their surfaces rubbed over with a solution of chloride of zinc (40 grs. to ℥j.), and packed with some antiseptic dressing.

It has been stated above that inflammation of the breast occurring in young girls may lay the foundation for chronic abscess; but this condition may also arise as the result of pregnancy, or from injury, or in some cases without any assignable cause. It is a disease of very considerable importance, on account of its great similarity as regards its symptoms to ordinary scirrhus of the breast, and to the great difficulty there is in some cases in coming to a correct diagnosis between the two conditions. It consists of a small collection of pus surrounded by a layer of dense indurated tissue, which gives to it a sensation of great hardness, and entirely obscures any feeling of fluctuation. It is not very distinctly circumscribed, and generally increases very slowly, or may even remain almost stationary for many months. It is often accompanied by retraction of the nipple.

The diagnosis of this condition from scirrhus must be made by the history of the case, for, except in young girls, it arises for the most part after lactation or after a miscarriage; by the fact that the induration is more leathery

and not of such stony hardness as scirrhus; that though the skin over it may be dimpled, it does not present the same pigskin appearance as it does over a carcinomatous tumour; and by the fact that there is usually more or less œdema of the subcutaneous connective tissue covering it. But in spite of these differences, the two diseases may be almost indistinguishable, except by puncture or incision, and this should never be neglected in any case where there is the slightest doubt as to the nature of the case, since it is an undoubted fact that many breasts have been removed under the supposition that the disease was scirrhus, when there was merely a deep-seated chronic abscess.

The treatment of chronic abscess consists in freely incising it and inserting a drainage-tube.

Chronic interstitial inflammation of the breast, with induration of various parts of it, is extremely common, and is very liable to be mistaken for tumour. In some cases it is the sequel of an acute attack of inflammation, in other instances the cause is obscure, but is frequently associated with some menstrual irregularity. Often the whole breast remains, after an acute attack of inflammation, hard, heavy, and somewhat tender. These cases are not so difficult of diagnosis, but when only a portion of the breast is indurated the hardened part much resembles a scirrhous or glandular tumour. The diagnosis can only be made by the fact that various separate lobules are usually affected, and often in both breasts, and by the general aspect of the case, and of the patient, to which Mr. Birkett adds as diagnostic signs that in these cases the pain usually follows the course and distribution of one or more nerves, and that if these nerves be sought for and pressed upon as they issue from the thorax the slightest pressure will induce acute pain, sometimes confined to a single branch distributed to the indurated part, while the rest are unaffected. This induced pain is, he says, almost pathognomonic of the disease. Another diagnostic sign on which he also lays stress is, that 'when the hand is pressed gently over the gland, nothing indicating the existence of a new growth is felt, which always happens when one exists—the induration is very distinct if compressed between the fingers and thumb, but imperceptible with the hand placed flatly on the part.'

Lobular
induration.

In treating this affection the first point is to improve the general health, to insist on healthy habits of exercise, to cure any menstrual irregularities, and to dissipate the apprehensions of tumour and cancer which the patient probably entertains. Quinine, iron, and mineral acids often do good if the digestion be attended to, and iodine internally is highly thought of by some surgeons. Local applications are always useful in removing the part from the patient's own constant inspection and handling, for which purpose a belladonna plaster may be used; the breast, if heavy and pendulous, must be supported from the opposite shoulder. In some cases, where pressure can be tolerated, strapping applied over a layer of mercurial ointment removes the induration. Where the evidences of inflammation are more distinct, evaporating and soothing lotions must be employed.

In other cases, even without any swelling or induration, the breast is the seat of almost intolerable pain, sometimes constant, sometimes periodic, and usually accompanied by hyperæsthesia of the skin of the breast, as well as by pain in the neighbouring parts. The affection is more common in young girls than in elderly persons, and in the unmarried than the married. It is usually associated with deranged menstruation, and probably with other disorders of health and digestion; and those who suffer from it may sometimes be found

Neuralgia,
or hysterical
pain.

to be addicted to depraved practices. The treatment consists in protecting the breast from all contact or examination. The organ will often be found to be hard, prominent, and congested; and in this condition, I believe, relief will often be obtained by tolerably firm strapping, which may be applied under anæsthesia if necessary. The bowels and the state of the menstrual secretion must be carefully attended to, and the moral treatment recommended for other nervous disorders must be strictly enforced, and it is unnecessary to say that any secret practices which may be detected must be put a stop to.

Functional disorders.

The secretion of milk may be disordered in various ways. It is said that in rare cases the breasts have been known to secrete milk quite independent of pregnancy—in old women, children, and virgins. Atrophy of the breast-tissue, causing absence of the secretion, has been referred to above. The opposite state, in which the secretion is excessive (*galactorrhœa*), or in which it does not cease on the cessation of suckling, is connected with derangement of the general health, and will subside as this is restored. The only derangement of secretion which constitutes a specific disease is congestion with milk, depending, it is believed, upon the more solid constituents of the milk being formed without the serum, so that the ducts and acini become choked, as it were, with the secretion. This sometimes leads to so much solidity and brawniness of the organ as to be taken for cancer, especially as the raising of the gland causes the nipple to be buried. The diagnosis is settled by observing that there was no tumour before delivery, and that cancer hardly ever begins during suckling. Abscess is to be apprehended, yet cases occur, according to Mr. Birkett, in which the congestion subsides and the breast is again quite useful. Only one breast is usually affected. The improvement of the general health, weaning the child, pressure with carefully applied strapping, or the application of belladonna with glycerine, tincture of iodine, or iodide of lead ointment, are the measures prescribed for the treatment of this condition.

Tumours of the breast.

Tumours of the breast, like tumours in general, are best divided, for purposes of description, into cystic and solid tumours.

Cystic tumours.

The cystic tumours of the breast may, again, be subdivided into cysts which grow as independent tumours and those which are formed in conjunction with the solid tumours. The former of these groups will only be described here, the latter being more conveniently considered in connection with the solid growths. The independent cystic tumours of the breast are of three different kinds: (1) retention cysts; (2) simple serous cysts; (3) parasitic cysts.

(1) Retention cysts are the most common of the independent cystic growths found in the breasts, and may arise in several different ways. Milk cysts, or '*galactoceles*,' are tumours which form during lactation, either from mere dilatation of an obstructed duct, or from its rupture and effusion of the milk into the neighbouring tissue. They almost always occur close to the nipple, and form single oblong tumours, painless and fluctuating, and generally covered by dilated veins. They may subside on the cessation of suckling, to recur at each of the following pregnancies, of which Mr. Birkett gives a remarkable instance. Sometimes their contents become semi-solid or cheesy, and they then present a considerable resemblance to a solid tumour. The cases are rare, and the diagnosis will be difficult unless the patient has been under observation and the sudden development of the tumour

during suckling has been noticed. Generally they are not diagnosed till after a puncture has been made, when the cyst must be emptied and made to heal by granulation. Another form of retention cyst of the breast occurs independently of lactation, and does not contain milk, but an abnormal secretion of the gland tissue, which is generally colourless, but may be brown or more or less straw-coloured. The disease occurs for the most part in women about the age of thirty-five who have borne children, and is often attributable to a blow. It may also occur in younger and unmarried women, and be caused by some undue excitement of the organ, as in a case related by Erichsen, in which it was caused by a young unmarried woman occasionally putting an infant, of which she had charge, to her breast in order to quiet it. The cysts generally take origin in the acini or smaller ducts, and from this they have been termed 'glandular' cysts. They may be single or multiple, and may vary in size from tumours of the size of a millet-seed to cysts capable of holding a very considerable amount of fluid. They are painless, smooth in outline, elastic, and of slow growth. Fluctuation cannot always be detected in them, and they have occasionally been mistaken for a solid growth, and the breast even removed under the supposition that they were scirrhus. A third form of retention cyst is the 'involution' cyst of females past middle age, and which is due to degenerative changes. They rarely attain a large size, and seldom give rise to any inconvenience, so that they are often never discovered during life.

(2) Simple serous cysts are small cysts which arise, not in the glandular structure as the result of retention, but in the lymph spaces of the connective tissue. Except in regard to their origin they resemble very much the glandular retention cysts above mentioned. They consist of a delicate sac wall of connective tissue, lined internally with a layer of flattened endothelial cells, similar to those found in lymphatic vessels. Their contents, like those of the glandular cysts, vary; sometimes consisting of a clear, straw-coloured serous fluid; at others of a brownish, turbid, or mucoid fluid. They grow slowly, and cause no pain, and often do not attract the patient's attention until they project under the skin.

(3) Hydatid cysts are extremely rare. The expression 'hydatid disease' in the older authors usually means the simple cystic or sero-cystic tumour of Brodie; but echinococci are sometimes found upon laying open what have been taken for common cysts or abscesses.

The treatment of cysts in the breast must vary with their number. A single thin-walled serous cyst may sometimes be cured by tapping; but usually the fluid re-accumulates, and they require an incision and washing out with a strong solution of chloride of zinc or iodine, or the cavity may be packed with iodoform gauze so as to make it granulate up. If the wall of the cyst is thick and surrounded by indurated glandular tissue, or if the cavity contains intracystic growths, it should be dissected out, together with the lobule of the gland with which it is connected. If the cysts in the breast are very numerous, the only remedy is to remove the whole of the gland, if the disease is causing decided annoyance, but this is rarely the case.

Many of the ordinary forms of tumour described on an earlier page are occasionally found to be located in the breast; such are the lipomata, fibromata, chondromata, myxomata, and angiomas; but they are of exceedingly rare occurrence, and differ in no wise from the same tumours in other parts, and require, therefore, no more than a passing notice. The remaining tumours,

Solid
tumour
of the
breast.

and ones which occur with much greater frequency, are the adenomata, sarcomata, and carcinomata.

Adenoma.

Under the head of adenoma are classed a large number of tumours which differ considerably from each other both in their structure and clinically, but have still the one essential feature of the presence of a certain amount of adenomatous tissue common to all. For it must be premised that a pure adenoma of the breast is amongst the rarest of tumours. The adenomata are composed of a tissue identical with a portion of imperfectly developed breast-structure; that is to say, of spaces lined with small cubical epithelium, mixed, in varying proportions, with some other structure. To these tumours the prefix *adeno* is applied, and when the material with which the spaces are surrounded is ordinary connective tissue, the tumour is termed an adeno-fibroma; when the interstitial tissue between the epithelium-lined spaces is composed of spindle, round, or giant cells, it is an adeno-sarcoma; and when the spaces themselves undergo a cystic formation, the tumour becomes an adeno-cystoma.

Pure adenomata consist of ordinary gland-tissue which has undergone an imperfect development, consisting of a number of acini and ducts massed together without any definite arrangement and without forming perfect gland-tissue, arranged in lobules, and with ducts communicating with each other. The acini and ducts are, however, identical in structure with those of normal gland-tissue, being made up of slit-like or flattened space with a distinct membrana propria lined by one or more layers of cubical epithelium. When these tumours occur they form hard nodulated masses, freely movable, and of slow growth. They are usually found in women of about thirty or thirty-five years of age.

Adeno-fibroma.

The adeno-fibromata are amongst the commonest of tumours of the breast of a non-malignant nature. They were formerly described by Sir A. Cooper as 'chronic mammary tumour,' and were regarded as fibrous growths. They are now frequently termed adenomata, or adenoid tumours; but it is better to apply the term adeno-fibromata to them, in order to distinguish them from the preceding group of tumours, which, though rare, constitute a distinct and separate class of growths. They form firm lobulated masses, surrounded by a capsule of fibrous tissue, in which, on microscopic examination, rudimentary breast-tissue is found, surrounded by fully developed connective tissue. They consist of a firm, hard, nodulated lump, which can sometimes be felt to be attached to the gland-tissue by a sort of pedicle, but at the same time is distinctly separable from it, and appears to float, as it were, in the substance of the breast. They occur in young women under the age of thirty, and are often associated with irregular menstruation and with a neurotic temperament. They are frequently attributed to some injury, as a blow or squeeze. They are usually of slow growth, and for the most part painless, though occasionally in the hysterical subject they are the seat of severe neuralgic pain. They may be mistaken for a cystic tumour, and the diagnosis is often difficult, or even impossible, without recourse to the exploring-needle. From carcinomata they are to be distinguished by the age of the patient, their better-defined and more distinctly circumscribed outline, and by the absence of dimpling of the skin, retraction of the nipple, and non-implication of the neighbouring lymphatic glands.

Adeno-sarcoma.

In the adeno-sarcomatous group, the tissue around the spaces, instead of consisting of ordinary fibrous tissue, is made up of simple embryonic tissue composed of cells—either round, spindle, stellate, or giant cells—in a mucoid

intercellular substance. These tumours usually grow rapidly, and speedily attain a large size. They are nodulated, elastic, and often scarcely to be distinguished from the adeno-cystomata. They are freely movable, both on the parts beneath and under the skin, which frequently becomes much thinned over them when they form prominent tumours projecting from some part of the breast.

The adeno-cystomata were originally described by Sir B. Brodie as *sero-cystic*, and by Mr. Cæsar Hawkins as *tubero-cystic* tumours. They are closely allied to the other forms of adenoid tumour, the difference merely consisting in the dilatation of the acini and imperfect ducts of the other forms into cysts or spaces of varying size. Into these cysts the tissue outside pushes its way, and forms growths within the cavity, which present a lobulated branched appearance, sometimes projecting from one wall of the cavity only, sometimes completely filling it, though without obliterating its epithelium-lined walls. On section the tumour presents innumerable cysts, varying in size from a pin's head to a cocoa-nut. The fluid within these cysts is generally thick and viscid, and often of a brownish or chocolate tint. The intracystic growths are for the most part pedunculated, and bear a striking resemblance to the head of a cauliflower. On section they are of firm consistence, and of a whitish colour.

Adeno-
cystoma or
cystic
sarcoma.

These tumours are generally found in women between the ages of 30 and 40, most frequently in those who have borne children. They commence as a firm, hard tumour, which may remain stationary, or grow only very slowly for some time, and then, without any apparent cause, commence to increase with great rapidity. This is due to one or more of the cysts taking on an active growth, and developing in size by the accumulation of fluid in their interior. If such a breast be examined there will be found to be one or more prominent fluctuating swellings, with a quantity of solid nodulated material at their base. The skin over the prominent swellings becomes thinned, and eventually reddened, but it is not until the cyst is about to burst that it becomes attached to the tumour, which is also freely movable on the parts beneath. The nipple is not retracted, and the axillary glands are not enlarged. Eventually, if left to itself the cyst bursts, and the intracystic growths protrude, forming a fungous mass, which bleeds, assumes a malignant aspect, and speedily kills the patient from exhaustion.

The only efficient treatment for adenomata or adeno-fibromata is removal ; but this is not always necessary. If the tumour is small, does not cause the patient any annoyance or inconvenience, and is not increasing in size, it may very well be left alone, and is said sometimes to have disappeared without treatment, especially if the breast has been called into a more active condition by the occurrence of pregnancy. If it be decided to leave it alone, pressure is sometimes believed to be of use, and to have caused the absorption of these tumours. In some cases, I have no doubt, the tumour persists because it is being constantly handled by the patient to see if it has increased ; and if means be taken to prevent this, it will disappear of itself. On two or three occasions I have found that the application of belladonna plaister spread on leather, so as to completely cover the breast, and forbidding the patient to handle it, or protecting it with a gutta-percha shield, has been followed by the most satisfactory results. If the tumour is accompanied by neuralgic pains it will generally be found that there is some uterine irregularity, and internal remedies must be administered to correct this. If it be determined to remove it, it is necessary only to excise the tumour, leaving the breast untouched ; and in all probability, if thoroughly removed, it will not return.

Treatment.

In the adeno-sarcomata and in the adeno-cystomata the only treatment is early and entire removal. In the majority of cases it will be found necessary to remove the whole breast, and if this is not done there is every probability of a recurrence. In some few instances where the disease is seen early and the tumour is of small size, an attempt may perhaps be made to save the organ. The recurrence takes place generally in or near the scar itself, and many cases are recorded in which the patient has preserved her general health entirely unaffected after the disease has recurred many times. In one remarkable case in Mr. Cæsar Hawkins's practice at St. George's Hospital it was not till after ten recurrences and eighteen years' duration of the case that the patient finally succumbed to exhaustion produced by the sloughing of the tumour, which at length it became impracticable to extirpate. These circumstances should teach caution in prognosis, and should incline the surgeon rather to remove the whole breast than merely extirpate the tumour whenever the growth is large and advancing rapidly, and particularly if the patient be somewhat advanced in years, or be from any cause unlikely to suckle.

Sarcoma.

Sarcoma in its various forms is met with in the breast as in other parts. It possesses no special characteristic, and differs in nowise from sarcomatous tumours in other situations. The spindle-celled sarcoma is believed to be the most common form, and sometimes springs from the subcutaneous tissue over the breast as from subcutaneous tissues elsewhere. The true sarcoma of the breast differs from the adeno-sarcoma in the entire absence of any trace of glandular structure. Cysts are occasionally met with in it, but they are not lined with epithelium as are the cysts in the adenoid variety, and are simply due to softening of the growth or extravasations of blood.

As regards the symptoms of these tumours, it is almost impossible to diagnose between the adeno-sarcoma and the true sarcoma before removal; but as the treatment is the same in both affections this is a matter of no great importance. It may be noted, however, that the sarcomata present less evidence of lobulation, have a less defined outline, and grow more rapidly than the adeno-sarcomata. The only treatment that can be adopted is the complete removal of the growth, or, better still, of the breast itself; but in spite of this they are prone to return, and the more malignant varieties are often reproduced in other organs, though the axillary glands are rarely affected.

Carcinoma.

Scirrhus is the form of cancer most commonly met with in the female breast, constituting probably from 85 to 90 per cent. of all cases, though medullary or soft cancer is not unknown. In addition to these principal varieties, colloid cancer, due to colloid degeneration of the cells of the growth, and cystic cancer, arising from softening and disintegration of the central parts of a soft cancer, are occasionally, but rarely, met with. Cornil and Ranvier have also described another form of cancer of the breast under the name of 'duct cancer,' in which the point of departure of the new epithelial formation is probably from the cells lining the ducts. In these cases the cancer-cells permeate the breast-tissue in narrow columns. It resembles ordinary cancer in infecting neighbouring parts, the lymphatic glands and distant organs; but the clinical features of the disease are not yet accurately determined.

With regard to the predisposing and exciting causes of cancer of the breast very little is known. Formerly, heredity was regarded as one of the great predisposing causes, and Sir J. Paget states that in his experience it is traceable in 1 case in 4. Less importance, however, is now attached to this than in former days, and an hereditary tendency is not believed to have so great an influence in the causation of the disease as was at one time supposed. As

regards age, the greatest number of cases undoubtedly occur between the ages of 40 and 50, but no period of life after puberty appears to be exempt from the occasional occurrence of the disease. It has been known to occur in young women little over 20, and, on the other hand, in old women between 70 and 80, or even later. As regards the local causes, any prolonged condition of irritation about the breast is, there can be little doubt, a precursor of cancer. Thus eczema or psoriasis of the nipple has been lately pointed out by Sir J. Paget as a frequent antecedent condition to the advent of cancer of the breast, and in many cases chronic induration, the result of acute inflammation and abscess, has also been a precursor of it. Blows or injuries are very often assigned by patients as the cause of the condition; and though this history must be always regarded with a certain amount of suspicion, there is a growing tendency on the part of surgeons to believe that this is not unfrequently a distinctly exciting cause. Scirrhus of the breast generally occurs as a hard nodule, but is occasionally of the diffused or infiltrating variety. In the nodular form it is a hard, more or less lobulated mass, which cannot be enucleated from the tissues in which it grows. On section it presents a yellowish semi-translucent appearance, marked by darker yellow specks, and permeated by white opaque bands. It exudes on pressure a thin milky juice. The central part of the growth is denser than the peripheral, and the cut surface is distinctly concave. Cysts are occasionally seen in it; they are small, and contain a clear, pale, or blood-stained fluid. The infiltrating form usually commences as several nodules, which become fused together and rapidly infiltrate the whole breast, which becomes enlarged, hard, and lobulated. This form of the disease grows with much greater rapidity than the isolated nodule, and speedily implicates the skin, which soon becomes adherent to and incorporated with the diseased gland. In some cases of scirrhus of the breast, as soon as the skin becomes involved the disease rapidly extends in this structure, so that the skin of the whole of the front of the chest may become affected and converted into a hard, tough, leathery material, of a dark, reddish brown colour, tightly stretched over the parts beneath. To this form a special name has been given—‘cancer en cuirasse.’ This condition may arise from continuous extension from the original mass, but for the most part arises from the growth of small independent nodules in the skin around the primary tumour, which then grow, coalesce, and become fused together, and are succeeded by the appearance of other nodules in the skin beyond.

Occasionally, and especially in old women, a scirrhus growth undergoes a withering process; the cells become granular and fatty, and the fibrous elements greatly increased in quantity, and the tumour slowly diminishes in size. This is known as ‘atrophic’ or ‘withering’ cancer, and may exist for many years without causing pain or inconvenience. The whole breast dwindles in size and the nipple deeply retracts. The disease nevertheless ends in implication of the glands and infection of distant parts.

The symptoms of scirrhus begin insidiously and without pain: The patient's attention is generally drawn to it by accidentally discovering a small lump, and not from any pain, which is usually absent in the early stage of the disease. The tumour presents itself as a small, hard, stony lump situated in the thickness of the gland, generally in the upper and outer quadrant of the breast, but sometimes close to the nipple. The size of the breast is noticed not to be much increased, even as the tumour enlarges, since the tissues around shrink as they become adherent to the tumour. It is to a certain extent defined in outline, without having a distinct circum-

Symptoms.

scribed margin, but merges into the healthy gland tissue, so that it is impossible exactly to differentiate the spot where the normal tissue ceases and the diseased structure begins. Even at an early period of the disease, dimpling of the skin, due to shrinking of the tumour, and adhesion of the cellular tissue to it, is to be seen. This is best demonstrated by grasping the tumour between the finger and thumb and tensing the skin over it, when the dimpling will be rendered evident. Retraction of the nipple, arising from the same cause, is a not uncommon symptom, the period at which it presents itself depending on the situation of the tumour. In those cases where the disease commences close to the nipple, the retraction takes place early; in those where the tumour is more remote, not till a later period. The early growth of the tumour is slow, and it is at first quite movable, but after a time the tumour becomes attached to the pectoral muscle and afterwards to the chest-wall. As the tumour progresses it infiltrates the skin, which becomes dusky red, leathery in consistence, and presents a pitted appearance, like pig-leather. At this time pain becomes a prominent symptom, and is of an acute and lancinating character, not only in the breast itself, but in the chest and neck and down the arm. Later on the skin ulcerates, forming the scirrhus ulcer, the edges of which are hard and raised, the surface unhealthy-looking and devoid of granulations, and frequently covered with a yellowish slough. The ulceration is often attended with hæmorrhage and an exceedingly fetid and offensive discharge. During this period the patient's sufferings become intense: from the pain and inability to sleep, from the fetid discharge, which destroys the appetite, and from the hæmorrhage, which exhausts her, she rapidly emaciates and loses strength, becomes sallow and wan-looking, and presents in a marked degree the so-called 'cancerous cachexia,' and finally succumbs from exhaustion, or from secondary infection in internal organs, or from a chronic blood-poisoning from absorption of the decomposing discharge; death, on the average, occurring in a little over two years from the commencement of the disease. Early in the course of the disease the axillary glands become affected; usually those first at the anterior and lower part of the axilla; sometimes also the subclavian and other cervical, and even the mediastinal, glands may become enlarged, and the arm often becomes cedematous from the pressure of these enlarged glands on the veins.

Diagnosis.

The diagnosis of the early stages of cancer of the breast is beset with difficulties, but at the same time the diagnosis in this stage is all-important, because it is in the early recognition of the disease that the great hope of cure is centred. It must be principally based on the following characteristics, which are the principal distinctions between a scirrhus and a non-malignant tumour of the breast. In the former the tumour is of stony hardness, knobby, and indistinctly circumscribed: though at first mobile, it speedily contracts adhesions to the cutaneous and deeper structures, producing dimpling of the skin, retraction of the nipple, and a certain fixedness to the subjacent parts; the skin, at the first simply dimpled, in the later stages becomes hard, brawny, pig-skinned, and finally red, and firmly fixed to the tumour; the pain, at first slight or absent, after a time becomes severe and lancinating; enlarged glands are to be felt in the axilla and above the clavicle, and finally the patient is generally over thirty years of age, and probably over forty. Should, however, any doubt remain, an exploratory incision should always be made before the removal of the breast is finally decided upon. By this means many accidents and histories of removal of the

breast for innocent tumours might be prevented. In the infiltrating form of scirrhus of the breast, the whole gland is enlarged, and the disease grows more rapidly than in the nodular form. The breast feels hard, nodulated, and the skin becomes extensively adherent at an early period. The nipple is depressed, not only from retraction, but from the growth of the tumour around it.

Bearing some resemblance to this, but of a still more rapid character as regards its growth, is the encephaloid or soft carcinoma of the breast; happily, however, a disease of rare occurrence. It begins as a round, movable tumour, but increases with frightful rapidity and infiltrates the whole gland rapidly. It begins at the same age and under the same conditions as scirrhus, but its malignant or infective characteristics are much more marked. It is tense and elastic, has a knobby feel, but not the stony hardness of scirrhus. The skin becomes speedily implicated, red, and œdematous, and then gives way, and the growth fungates out of the ulcer in the form of a large mass, from which hæmorrhage is very liable to take place. The disease to a certain extent resembles, and is liable to be mistaken for, round-celled sarcoma, but differs from it in the fact that it is an infiltrating growth without circumscribed limits, whereas the sarcoma is distinctly encapsuled and circumscribed. The average duration of life in these cases is under a year, and removal does not offer any prospect of any great prolongation of life, the disease speedily re-appearing in some internal organ or recurring in the cicatrix.

When the diagnosis has been made the question of the removal of the disease has to be discussed. There is not, I think, any convincing evidence either way as to whether the operation prolongs life or shortens it, on the average of a large number of cases; but I do not see that this tells conclusively either for or against the operation. The operation frees the patient for a time from the oppression of a disease which is known to be gradually advancing to a fatal issue; it renders the interval (allowing that the cancer recurs) one of complete health for the greater part of the time, instead of being a period of pain and anxiety; it gives the patient a chance, however slender, of immunity from recurrence; and in many cases the cancer recurring in an internal organ, such as the liver, terminates life in a less painful manner than by the spread and ulceration of an external tumour. The operation, in these days of anæsthesia and of rapid healing of wounds, is not one of much danger or suffering.

Question of
operation.

The contra-indications to the removal of the breast for cancer are either absolute or partial. The spreading of the cancer so far into the skin or neighbouring parts that the surgeon cannot operate through healthy tissue, the implication of the glands beyond the axilla (in the subclavian triangle, or higher in the neck), the deposition of cancer in other parts, or an advanced condition of cancerous cachexia, are absolute contra-indications. The infiltration of the skin to any extent, however small, the ulceration of the tumour, or any implication of the axillary glands are very unfavourable conditions, though under certain circumstances the surgeon may be justified in operating. It is true that all the visibly diseased skin may be removed with the breast; that the removal of an ulcerated and bleeding mass may produce great temporary relief; and that all the visibly enlarged axillary glands may possibly be excised. The latter point, however, is always doubtful, and the surgeon will often discover when he opens the axilla, expecting only to find one or two small scirrhus glands, that in reality the whole chain of glands is implicated, and that he is committed to a deep and dangerous dissection, which

possibly has ultimately to be abandoned without the whole of the diseased glands having been removed. But, however complete the apparent removal may have been, a speedy return of the disease in the cicatrix may always be prognosticated under the conditions specified, so that the operation must under such circumstances at the best be regarded as only a palliative. The cases most suitable for operation are those where the disease is recognised early; where the tumour is of moderate size, of slow growth, not adherent to the parts beneath; and in which there is no enlargement of the axillary or other lymphatic glands, provided always that the patient is not suffering from any constitutional disease.

Repetition
of opera-
tion.

With regard to the repetition of an operation, the same considerations exactly apply. Under circumstances which would have justified the original operation it may be repeated, and even more than once, in the cicatrix.

Use of
caustics.

That cancerous breasts may be successfully removed by caustics is amply proved by experience. The method is much inferior to removal by the knife, being slower, more painful, and less certain to expose healthy tissue; but the fear of a cutting operation renders the alternative acceptable to many, and the cancer-curing quacks make a livelihood chiefly by concealing some of the common potential cauteries—generally chloride of zinc—with some inert nostrum. On the whole, the chloride of zinc is the best of these caustics, and is, I think, best used on the method of Maisonneuve, ‘cauterisation en flèches,’ which will be found described in Chap. XLIII. The method introduced by Fell, of destroying the skin by means of some strong acid, then scoring the exposed surface and stuffing the incisions with the chloride of zinc paste, saves some time and pain.

Treatment
of ulcera-
ted cancer.

It is, however, in the treatment of cancerous ulceration that the application of caustics is most frequently advisable. When the ulcer is of limited extent the caustic often gives little pain, and the separation of the eschar is sometimes followed by temporary cicatrisation. Otherwise nothing can be done in ulcerated cancer except to keep the part as free from odour as possible with some of the tarry solutions, and to soothe pain with morphia. I have found nothing better than the carbolic lotion covered with carded oakum. But the patient may get tired of the odour of this dressing, and then solution of chloride of zinc, or Condry's lotion, or solution of perchloride of carbon or chlorate of potash may be used, mixed with laudanum or belladonna. The balsam of Gurjon, recently introduced, and the boracic acid lately recommended by Prof. Lister for its deodorising qualities, have not answered in the trials I have made of them.

Removal
of mamma.

In amputating the mamma it is always advisable, whenever it can be done consistently with removing the whole disease, to leave sufficient skin to cover the wound without any tension. This, however, should be a matter of secondary consideration, and whenever the whole of the implicated skin, and a considerable area of apparently normal skin around, cannot be removed without leaving an open wound, this should be done, regardless of the fact that the edges of the flaps cannot be approximated. The nipple should be included between two curvilinear incisions, which are generally made to lie above and below it, though this is a matter almost of indifference. The angle of junction of the incisions outwards can easily be prolonged into the axilla if any glands are to be removed from thence, and this is better than to make a separate small incision over the glands themselves. The lower flap is to be first dissected back, down to the base of the tumour or of the breast, then the upper, these flaps being made as thick as is consistent with

keeping well away from the disease. The breast, being now fully exposed, is to be forcibly drawn away from the pectoral muscle, and the cellular tissue which unites them divided by rapid strokes of the knife, the assistant putting his fingers on the bleeding vessels, which should then be rapidly secured with carbolised catgut ligatures. When all bleeding has been thus commanded, the wound is to be united by sutures, and dressed according to any plan which the surgeon prefers as likely to procure speedy union. Very often a large part, and in some cases the whole, of the wound unites by primary union.

Recently Mitchell Banks and Gross have advocated a much more radical proceeding for cancer of the breast, with the view of 'thoroughly uprooting every particle of disease.' The breast is removed, together with all the skin over it, without any heed being taken for the manufacture of flaps to close in the wound; and removal of the axillary glands is an invariable accompaniment of the operation, whether these structures can be felt to be enlarged or not. The fascia over the great pectoral muscle is also removed. This proceeding adds considerably to the dangers of the operation, and Mr. Mitchell Banks himself admits that the mortality would be probably 15 per cent.; but he argues that though it will be fatal to a certain number of persons, it will save the lives of many more.

Malformations are common in the nipple. It is sometimes bifid, sometimes multiple, far more often deficient or ill-developed; and such ill-developed nipples are fruitful causes of trouble in suckling, as pointed out above. It may be possible, in some cases, where the nipple is merely short but otherwise natural, to draw it out by constant well-directed pressure by means of a breast-pump, and the attempt is worth making in a married woman before she becomes pregnant, or during pregnancy. Inflammation of the nipples and small ulcers, or cracks, on them, are very common, especially during a first suckling. The ulcers should be carefully cleaned, covered with fine powder, as oxide of zinc, dusted on them through a muslin bag; or coated with collodion, and protected by a shield from direct contact with the infant's mouth. When abscess forms near the nipple it should be allowed to burst, or at least to come close to the surface, for fear that in opening it the milk-sinus should be wounded.

Diseases
of the
nipple.

The nipple and areola are occasionally found to be the seat of epithelioma. I once treated a case of this kind in a married lady, who from some malformation had (as I was informed) never been capable of complete sexual intercourse. The nature of the disease was indubitable, and was proved afterwards by microscopic examination. There was a small hard gland in the axilla, which was not removed; but the nipple and areola were fully excised. I saw her five years afterwards in perfect health, and the gland had quite disappeared. Such a case, however, should be carefully watched; and on the appearance of any recurrence and extension of disease to the breast the whole organ should be removed.

Sir J. Paget has lately called attention¹ to the frequency with which an obstinate eruption of the nipple and areola, resembling eczema or psoriasis, is the precursor of cancer in the mammary gland. The eruption is very rebellious to treatment, and usually persists till the period at which the cancer appears. He has noticed fifteen cases, in all of which the cancer showed

¹ 'St. Bartholomew's Hosp. Reports,' vol. x. p. 87.

itself within two, and in most within one year after the eruption. The cancer is not continuous with the diseased nipple, but grows in a remote part of the gland. In such cases, particularly when cancer is known to have existed in the patient's family, he believes the diseased skin ought to be removed or destroyed.

The nipple is sometimes the seat of common sebaceous or cystic tumours and of nævi, but their treatment is the same as in other regions. Great care, however, must be taken not to induce deformity by any operative measures undertaken for their cure.

Diseases of
male
breast.

Analogous affections sometimes, though rarely, attack the male breast. The irritation which in male infants sometimes leads to a secretion of milk has been spoken of. In later life tumours form in the male breast which are usually of a scirrhus nature, sometimes fibrous, and I have once seen a case of serocystic tumour, precisely like the same disease in the female.¹ The disease occurred in a man aged 54. The diagnosis of these affections is much the same in the male breast as in the female. Any growth which forms in this situation should be at once removed.

¹ St. George's Hospital Museum, Ser. xv. No. 50.

CHAPTER XLII.

DISEASES OF THE THYROID BODY.

THE thyroid gland is liable to an endemic enlargement, which is called Endemic goître, and which prevails extensively in the valleys of many mountain regions in various parts of the globe. It occurs for the most part in valleys which run north and south, where the sun rarely shines, or at the most for a few hours each day, and where the air is damp and stagnant. Cretinism also prevails usually in the same locality, either in the same or different persons. In this country the endemic form of bronchocele is known as 'Derbyshire neck,' from the place where it chiefly prevails.

More important in practical surgery, though far less so in public hygiene, are the sporadic cases of bronchocele which are seen pretty commonly in all parts of the country, especially in large towns amongst the dwellers in courts and alleys, and those who live in cellars where the sun does not readily penetrate. Most of the patients are females, and usually are married. There is very commonly some menstrual irregularity; yet the general health is often perfectly good.

The disease shows itself in several different forms. Sometimes it consists in a simple enlargement or hypertrophy of one or both sides of the thyroid body along with its isthmus—*simple hypertrophy*. It then forms a soft and elastic tumour, retaining somewhat the shape of the gland, which moves upwards and downwards with the trachea in deglutition. Sometimes it extends behind the trachea, and has been known to produce death from this cause.¹ Sometimes, also, it seems to cause loss of voice from pressure on the recurrent laryngeal nerves, or even spasm of the glottis from irritation of the same nerve. Again, there are other cases where the fibrous stroma of the organ undergoes the greatest amount of hypertrophy and the tumour is indurated—*fibrous bronchocele*. These growths do not retain the original form of the gland, but become irregularly nodulated, and produce much greater pressure effects than the simple variety. A third form of bronchocele is the *cystic bronchocele*, in which one or more large cysts are developed, surrounded by hypertrophied gland-structure. These cysts, especially if there be only one, sometimes contain a clear serous fluid, at others a brownish or chocolate-coloured grumous fluid; and, again, in some cases are filled with a colloid material. Finally, *pulsating bronchoceles* are occasionally met with, in which the gland is swollen and enlarged and pulsates forcibly. The pulsation is synchronous with the heart's action, and of a distensile character.

The treatment of the disease which is most relied upon is by the external and internal use of iodine, due attention being given to the general health, and especially the menstrual functions. Sir Morell Mackenzie has² called attention to the benefit which may be produced in cystic bronchocele by the injection of perchloride of iron. His plan is to tap the cyst, then to inject ʒi. or ʒij. (according to the size of the cyst) of a solution of perchloride of

¹ See a case related by Dr. Dickinson, 'Path. Soc. Trans.' vol. xii. p. 229.

² 'Clin. Soc. Trans.' vol. vii. p. 115.

iron (5ij. : ʒi.); this is left in the cyst for about three days, the cannula being plugged and retained, when the iron is allowed to escape, and the part is poulticed, the plug being still retained until suppuration is fairly established, when it may be removed. I have followed his directions with much success in a case of very large thyroid cyst. In fibrocystic bronchocele, after the cysts have been thus obliterated, the solid part is treated by subcutaneous injection of iodine, but this is undeniably dangerous. These cysts are often treated by seton—a practice which, though it is sometimes very successful, is not without its dangers. Latterly the injection of thyroid tumours with ergotine, or with the fluid extract of ergot, has been tried, and I have treated a few cases in this way, but hitherto with no decisive benefit.

Removal of
broncho-
cele.

In some cases it seems to me justifiable to remove such tumours, i.e. either where they threaten to prove fatal by great and increasing pressure on the windpipe or other structures in the neck, or when, as in my case (recorded in the 'Amer. Journ. of Med. Sci.' Jan. 1873), the tumour has burst and the suppuration is exhausting the patient. The operation is a formidable one, but has often been performed with success.¹ The operation is best performed by very free incisions, followed by a careful dissection, in which all the large veins (which are very numerous) are divided between two ligatures, as well as the thyroid arteries or any of their large branches. The incision should run vertically from the sternal notch to the upper part of the swelling, whence it should incline outwards as far as may be necessary towards the ear on one or both sides, according as the tumour is uni- or bi-lateral. The superficial veins are first exposed, tied, and divided. Then the superior thyroid artery and veins are secured, and the other vessels as they appear. The muscles which cover the tumour are to be freely divided. As the tumour is freed from its connections it is cautiously lifted, and the inferior thyroid or its branches are tied. The recurrent laryngeal nerve is in danger in this part of the operation, and opinions are divided as to whether it is better to tie the trunk of the artery as far away from the tumour as possible, or to apply ligatures to the branches as they enter the gland. Sir W. MacCormac recommends the latter course. If only one side of the thyroid is to be removed, after the communicating veins are secured the isthmus is divided, each bleeding-point being tied. Tracheotomy may become necessary, but should only be performed in case of absolute necessity, for it seems to complicate the case much, and to induce putrefaction of the wound.

The operation is a dangerous and difficult one, requiring good light and ample room, and should be conducted with great deliberation. The great point of interest at present in connection with the operation of complete extirpation of the thyroid body is the probability of the subsequent occurrence of a condition resembling myxœdema, and to which Kocher has given the name of cachexia strumipriva. Of the 101 cases referred to in the footnote, Kocher states that he has been able to trace eighteen cases and personally

¹ See especially a paper by Dr. Greene of Portland, Maine, in the 'Amer. Journ. Med. Sci.' Jan. 1871. Dr. P. H. Watson ('Brit. Med. Journ.' Sept. 25, 1875) relates the history of six cases, with only one death. Billroth is referred to by Sir W. MacCormac as having operated in 68 cases with a mortality of only a little over 7 per cent., and Kocher 101 times with 13 deaths. A very interesting pamphlet on this subject has lately been published by M. Riverdin (extracted from the 'Revue Médicale de la Suisse Romande,' April 15, 1883), containing the history of 22 operations, only two of which proved fatal, and very valuable data as to their after-progress, and as to the indication for and method of operating. See also Sir W. MacCormac's address in 'Brit. Med. Journ.' Aug. 2, 1884.

examine them. In only two was the health perfect. 'The remaining sixteen showed, in a greater or less degree, symptoms consisting in sensations of fatigue, weakness and weight of limbs, pain in arms and legs, feeling of cold in the extremities, which in the winter swell and become bluish-red in colour. The mental condition is duller, especially in children; their power of thinking and speech slower. This slowness of speech was strikingly characteristic of nearly all the cases. The face, hands, and feet showed swellings, lasting an hour or two, often most notable in the morning. The eyelids, more especially the lower, are swollen, and the face generally puffy.'¹ These observations throw considerable light upon the subject of 'Myxœdema,' in which atrophy of the thyroid gland has been observed to be an important characteristic.

Ligature of the thyroid arteries has been resorted to by some surgeons, with a view to curing this affection, but the amount of success which has followed the operation has not been such as to induce surgeons of the present day to practise the operation to any large extent. Tillaux recommends excision of the isthmus in cases of bronchocele, and this operation has been performed and advocated by Sydney Jones in this country. The operation consists in exposing the isthmus by a median incision, tying it at either extremity, and excising the intermediate portion. It has been said to be followed by atrophy of the lateral lobes, but the rationale of the proceeding is not very intelligible.

A singular malady affects the thyroid body, amongst other parts, which is generally called exophthalmic bronchocele, from the protrusion of the eyes, which is one of the prominent symptoms. There is palpitation of the heart, great rapidity of the pulse, extreme prominence of the eyes, and a large soft pulsating swelling of the thyroid body, in which a musical bruit can often be heard, and which varies greatly in size. Another prominent symptom is the jerking pulse in the carotid arteries. In one unfortunate case I saw both corneæ slough and the eyeballs wither away in consequence of their continued exposure. This form of bronchocele is sometimes accompanied by organic disease of the heart; otherwise it is not very dangerous to life, and under proper treatment there is a good chance of recovery. It often depends in some measure on mental causes, and is frequently associated with irregular menstruation. All concomitant circumstances of this kind being ascertained and treated as best may be, digitalis and iron seem to be the most promising internal remedies, and ice to the thyroid tumour the best local application. The reader is referred to works on Medicine for a fuller account of this affection, which falls more commonly under the physician's care.

Exophthalmic goitre.

Malignant disease occurs in the thyroid body; but it is very rare. Mr. Haward² refers, however, to a few cases recorded by Mr. Cæsar Hawkins and other authors; but the disease is not within the range of surgical treatment.

Cancer of the thyroid body.

¹ 'Brit. Med. Journ.' August 2, 1884, p. 231.

² 'Syst. of Surg.' 3rd ed., vol. iii. p. 596.

CHAPTER XLII.

DISEASES OF THE SKIN AND ITS APPENDAGES.

It seems necessary to give in this work a general idea of the diseases of the skin, although the subject is so extensive, and the practical considerations connected with the treatment of skin-diseases are so very numerous and complicated, that it is quite impossible for me to attempt anything here beyond the barest outline, and this chiefly with the view of rendering what has been said in previous pages intelligible. But in order to acquire a useful knowledge of the matter and to be able readily to distinguish the various eruptions from each other, it is absolutely necessary to study these diseases in the living body, comparing the eruptions seen in the out-patient rooms or in the wards with the drawings and descriptions which are given in approved authors, and with the models to be found in the Museum of the College of Surgeons and elsewhere.

Affections of the cutaneous system are divided into those of the skin itself and those of its appendages, the hair, nails, and cellular tissue. We will speak first of the eruptions of the skin itself.

The anatomical classification of these eruptions is the most obvious and the most useful in practice—viz. into (1) Exanthemata, or rashes; (2) Hæmorrhages; (3) Vesicles; (4) Blebs; (5) Pustules; (6) Papules; (7) Scales; (8) Tubercles; (9) Stains; and (10) Parasites—to which certain conditions are to be added, named ‘Xerodermata,’ resulting from unnatural dryness of the skin.

Exanthemata, or rashes.

Exanthemata—or rashes—are eruptions characterised by the occurrence of patches of skin which are injected and red, and thickened in consequence of being injected, but in which there is not necessarily any inflammatory effusion. The epidermis usually desquamates on the subsidence of an exanthematous eruption.

The skin-eruptions which are properly classed as exanthemata are roseola and erythema. Urticaria so closely resembles some varieties of erythema that it is usually described along with it, though it is not truly an exanthem. Many fevers are accompanied by exanthematous eruptions; but they are not spoken of here, since in them the eruption is only a subordinate symptom.

I have enumerated and described the varieties of erythema in a previous chapter (pp. 58, 59) in connection with erysipelas, so that the only true exanthematous disease left for description here is roseola.

Roseola.

This arises from various causes, but is always of constitutional origin.¹ It is characterised by small rose-coloured spots, or a roseate mottling of the skin. Some of its varieties (*R. infantilis* and *R. æstiva*) approach very nearly in character to the eruption of measles, and are accompanied by some fever and sore-throat, but are not marked by the coryza of measles. These varieties sometimes bear the name of ‘*morbilli nothi*’—bastard measles.

¹ ‘The eruptions proper to typhus fever, measles, German measles, typhoid fever, scarlet fever, and cholera are in reality roseola.’—Bristowe.

Another form of roseola is that which sometimes precedes the small-pox eruption, and occasionally that of cow-pox. Roseola also is found in gout and rheumatism. Another form of roseola is found in definite rings—roseola annulata—hardly to be distinguished from erythema marginatum. This is merely a symptom of deranged digestion. In fact, all these varieties of roseola are in themselves insignificant, although the constitutional condition on which they depend may be of the gravest possible import. The varieties of roseola which constitute substantive diseases require only attention to the state of the digestive organs, and in infancy to that of the dentition, with moderate purging and free action of the skin.

In young persons, especially girls, suffering for the first time from syphilis, an eruption is constantly seen which is classed by many under the name of roseola, less red in colour than the non-syphilitic varieties of the disease, and nearly allied to pityriasis. Like the latter eruption, its favourite seat is the chest. It will rapidly disappear under the endermic use of mercury. Syphilitic
roseola.

Urticaria, or nettle-rash, is usually described along with the exanthemata, though not properly belonging to that class; since in urticaria there is not only redness fading on pressure, as in the exanthematous eruptions, but also elevated flat patches of skin called wheals or 'pomphi.' These wheals are seated on the red patch of skin, and they testify to the effusion of serum into the tissue of the cutis, just as the wheals which occur in insect-bites do, and as the wheals which follow a lash testify to effusion into the substance of the skin. These wheals tingle and burn like the stings of nettles. Urticaria is excited by all sorts of causes which disturb digestion: errors in diet, especially the eating of shellfish by those with whom it acts as a kind of poison, or from local irritation of the skin. These kinds of urticaria are acute and transitory, and can be cured by the withdrawal of their causes, an emetic if needful, and a mercurial purge. There are other varieties of urticaria which are chronic. In some of these the individual wheals disappear while others come out—*U. evanida*; in others, on the contrary, they are persistent—*U. perstans*; other minuter differences in the arrangement and size of the wheals are expressed by the terms *U. conferta*, *U. tuberosa*; and a kind in which the causes and the symptoms of urticaria are present, the burning, tingling, &c., but no wheals are seen, is called *U. subcutanea*. In these more obstinate cases of urticaria the first care is to soothe the irritation of the skin by some wash. Lemon-juice or vinegar often succeed. Sir Erasmus Wilson prescribes hydr. perchlor. gr. v.–x., sp. ros. marini, sp. vin. tenuior. āā, ℥j., emuls. amygdal. amar. ℥vj. A dilute solution of prussic acid and almond emulsion is often very grateful. The next point is to discover and correct any error in diet or regimen, and to try the effect of copious diaphoresis, combined with change of air, active exercise, and sea-bathing. In other cases, arsenic, quinine, colchicum, or alkaline medicines have acted beneficially. Urticaria.

The hæmorrhagic diseases of the skin are purpura and scurvy. Purpura is characterised by spots (petechiæ) or large patches (vibices) of ecchymosis under the skin, which are easily distinguished from every other form of spot by their persistence under pressure, and by their changing colour with time, as bruises do. Purpura hæmorrhagica is a severer form of the disease, in which blood exudes from the mucous cavities, as in hæmophililia (p. 90). Purpura is merely a symptom of some disorder of the health or the blood, and its treatment must depend on a thorough knowledge of its cause. Hæmor-
rhagia.
Purpura
Scorbutus.

Without this the ordinary astringents and hæmostatics will be prescribed in vain.

Scurvy is a specific disease, and in no other sense a disease of the skin than that one of its symptoms is subcutaneous hæmorrhage in the form of vibices and petechiæ, just as the bleeding of the gums is another and still more prominent symptom.

Vesiculæ.

A vesicle is a small elevation of the epidermis, which is separated from the true skin by the effusion between them of a clear serum. This is usually the result of inflammation, and accordingly the neighbouring skin is generally seen to be red and congested.

The vesicular eruptions are sudamina, miliaria, eczema, and herpes.

**Sudamina
and milia-
ria.**

The two first fall within the province of the physician, sudamina being the small clear vesicles which appear in the course of certain fevers, apparently only as the result of obstruction of the sweat-ducts, and vanish in a day or two. Miliaria are vesicles which are found in acute rheumatism, and in children or adults with very tender skin in the summer months, often mixed with roseola, and display more distinct traces of inflammation than sudamina do, being surrounded by a red halo, and easily passing on to suppuration. In some cases a fever accompanied by miliary vesicles (miliary fever) prevails as an epidemic.

Eczema.

Eczema is the commonest of all skin-diseases. It is characterised by the eruption on patches of inflamed skin of a thick crop of small vesicles, together with scattered vesicles, each surrounded by its halo of vascularity, but unaccompanied by any diffused inflammation of the skin. The vesicles burst, and the epidermis then may form scabs or scales on the surface, so that the eruption in this state may appear to be squamous; or, on the other hand, the fluid in the vesicles may become purulent, and then the eruption will resemble the pustular—impetigo. Successive crops of vesicles may make their appearance as the former die away. The fluid is strongly alkaline in reaction, and often as it oozes away it seems to scald or burn the skin, and a smarting sensation in the parts often accompanies the eruption and justifies its appellation. It is a very common eruption on the leg, and is often accompanied by an ulcer—the eczematous ulcer above described (p. 420). Eczema is often nearly allied to gout, and the urine accordingly will be found to contain lithic acid or oxalate of lime.

Varieties of eczema are described by Hebra without any vesicular eruption—i.e. a diffused inflammation of the skin resembling eczema in its constitutional complications (or rather causes) and in its seat, but characterised by the separation of the epidermis from the skin in papules, scales, or pustules, instead of vesicles. The papular form would be classed by others as lichen eczematodes, the scaly as pityriasis rubra, the pustular as impetigo or eczema impetiginodes; but the differences are obviously immaterial.

The recognised varieties of eczema are *E. simplex*, when the inflammation of the neighbouring skin is not severe; *E. rubrum*, when the skin is much inflamed; and *E. impetiginodes*, when the vesicles rapidly suppurate or are mixed with pustules. Hebra describes a form as *E. marginatum*, which is by many writers considered to be syphilitic, and there is no question that eczema may appear as a secondary syphilitic eruption, though it is not a common symptom of syphilis.

**Syphilitic
eczema.**

Eczema appears at all periods of life and in all parts of the body. 'The face, the hairy scalp, and the skin behind the ears are all common seats of

eczema; but there is no part of the trunk or extremities which it may not, nay, does not, frequently affect. Before and during the first dentition, eczema is by far the most common of the diseases of the scalp.—Jenner. It is never contagious.

Its causes are constitutional and local; the latter depending sometimes on the irritation of itch, or parasitic animals, or on that of the material in which the patient works, as the ‘bakers’ itch.’ These varieties are the most easily cured by withdrawing the irritation on which the disease depends. The kinds of eczema which depend on gouty, strumous, diabetic, and other constitutional conditions are often excessively obstinate.

The treatment will consist in the first place in discovering and, if possible, counteracting the causes on which the inflammation depends, then in diminishing the inflammation of the skin by soothing and slightly astringent lotions or ointments, accompanied, of course, by suitable position of the parts, with moderate purgation and an antacid regimen if the condition of the urine indicates it; and in the more chronic condition, when the disease approaches more to the scaly eruptions, by the application of some of the tarry substances (such as the ung. picis liquidæ or the petroleum Barbadosense), with a course of arsenic. If syphilis be present or suspected, a mild and prolonged course of mercury or mercurial fumigation should be tried. When the scalp is affected, the hair must be most thoroughly and carefully removed with scissors, and the scales and scabs detached by a cap of gruel or a bread-and-milk poultice or linseed oil; after which Hebra recommends the application of liquid pitch if there is not much inflammation. While the eruption is in the ‘weeping’ stage the discharge must be absorbed by blotting-paper, or wet strapping, or soda lotion (sodæ subcarbonat. ʒij. aquæ Ojss.).

Herpes is an eruption of vesicles situated in small groups on slightly inflamed skin. It differs from eczema in many respects, chiefly in the fact that the vesicles form a far more prominent feature of the eruption than in eczema, and the inflammation of the skin is far less marked. The vesicles are usually larger than in eczema, and the fluid which they contain is less alkaline. There is also no connection with chronic constitutional disease, or with any abiding local irritation, such as is constantly found in eczema.

Herpes.

The varieties of herpes are as follows :—

Herpes labialis is a very common affection which occurs sometimes from cold, but often with no affection of the health whatever. The vesicles become more or less pustular, then crack, and the scabs fall off and leave the skin below a little irritable for a few days, the whole affair being generally over in about a week. The prepuce is another common seat of herpes, and when these little cracks occur after a suspicious connection they often cause the patient much alarm. Their number and their perfectly superficial situation will disclose their nature, and the application of a little mild mercurial ointment will in a few days remove all cause for apprehension. No treatment is required for these simple forms of herpes beyond a purge, some care in diet, and the use of citrine ointment, or an ointment of grey oxide of mercury, gr. x.—xv. to the oz. Lemon-juice is a favourite application in herpes labialis, and there are a thousand domestic remedies for what is after all a spontaneously curable affection.

Another form of herpes follows the distribution of one of the sensory nerves, and is often complicated by severe neuralgia of that nerve. The best known example is herpes zoster, or shingles (*cingulum*, a girdle), which follows the distribution of one of the intercostal nerves, extending from the back to

the sternum.¹ This is generally preceded by some fever and severe pain in the part, and often neuralgia persists in the part for some time afterwards. In some few cases the herpetic patches ulcerate, or even slough. The eruption runs its course in about a fortnight, and is said seldom to affect the same individual twice. It requires in itself no treatment beyond a purge and some soothing application. The neuralgia which it leaves behind may require prolonged and careful management. Other forms of neuralgic herpes occur in the face, following the distribution of the fifth nerve, and sometimes complicated with iritis, and in other nerves also, but more rarely.

Herpes phlyctenodes is a variety found on the face, in which the vesicles are unusually large. H. iris is a rare variety, in which there is a ring of vesicles arranged around a central one, and each surrounded by concentric circles of various shades of red. It is found usually on the back of the hand.

H. circinnatus is when the eruption occurs in a red ring and spreads from the centre. Sometimes the vesicles are large, and it runs the ordinary course of herpes in other parts, disappearing in about a fortnight. But the form of the disease in which the vesicles are so minute that they often pass unnoticed, and the eruption appears to be of a furfuraceous character, is exceedingly obstinate, and is one of the eruptions known in popular parlance as 'the ringworm.' It occurs on the face, trunk, and extremities, and is contagious; is often mixed with the parasitic disease—*tinea tonsurans*—on the scalp; and its secretions seem to afford a nidus in which the parasite grows. The eruption spreads centrifugally; the original ring disappearing and giving place to a larger one, and so on. Its causes are local, and it is curable by local treatment—the application of strong astringents, as sulphate of iron or gallic acid—of strong acetic acid, nitrate of silver, or blistering fluid.

Bullæ. A bulla or bleb differs from a vesicle only in size. It is a cavity between the skin and epidermis filled with serous fluid.

The bullous eruptions are two—pemphigus and rupia.

Pemphigus. Pemphigus, otherwise called pompholyx, is an eruption of large bullæ, often in small numbers, sometimes even solitary, with little or no inflammation around them, attaining in some cases an enormous size, and containing pure serum, alkaline at first, which may turn acid and become puriform. The bullæ burst and the epidermis dries down into a scab, while fresh bullæ probably form.

Syphilitic pemphigus. Pemphigus is sometimes due in infancy, no doubt, to congenital syphilis, and this is distinguished from the ordinary eruption by appearing on the feet and hands, and in some other cases it may be a tertiary symptom in later life. It occurs also as an acute disease attended with a febrile disturbance—*febris bullosa*. It also occurs in an acute form in old and cachectic persons; but more commonly it is a chronic eruption, and depending on visceral disease.

The treatment must be directed mainly to the constitutional condition. In the syphilitic variety iodide of potassium is indicated, with generous diet and opium. In cachectic persons the treatment must vary with the nature of the cachexia.

The blebs should be pricked, the part pencilled with a strong solution of nitrate of silver (5j. : 3j.), and after the cuticle has been thus hardened into a

¹ In some cases it is found in the course of the intercosto-humeral branch as well as the intercostal trunk.

scab this should be detached by a poultice. If the cutis be ulcerated below, the ulcer should be stimulated with nitrate of silver.

Rupia originates as a bullous eruption, the bullæ being comparatively small and seated on an inflamed base; but the contents of the bullæ soon become purulent, and the pus dries up into a rough, coarse, prominent scab which remains attached for some time, and when it falls off leaves a circular ulcer—the rupial ulcer. Sometimes the ulcer spreads without any falling off of the scab, and then a larger scab forms under the original one and raises it up, and so on until a projecting mass of scab is formed like a limpet-shell. This variety is called *R. prominens*. Other varieties are *R. escharotica*, marked by a spreading or phagedænic condition of the rupial ulcer, and *R. gangrænosa*, when the surface of the ulcer sloughs. Rupia.

Rupia, particularly the *R. prominens*, is a frequent symptom of tertiary syphilis, especially in cachectic or dissipated persons, but it occurs also in other conditions of general cachexia. Syphilitic
rupia.

In its second stage, when the contents of the bullæ have become purulent, it is hardly to be diagnosed from ecthyma, except by the more decided inflammation round the pustules in the latter disease. Later on, the prominence of the scab in rupia is plainly distinguished from the sunken adherent scab of ecthyma.

The treatment of all forms of rupia must be by support and stimulants; for the patients are always broken down in health. In the syphilitic variety, rest, shelter, equable temperature, good diet, opium, and sarsaparilla should precede any specific treatment. Then iodide of potassium may be administered for a long time, followed by mild mercurial fumigation. In other cases various tonics and stimulants will be found serviceable. In the earlier stage of the eruption the bullæ should be punctured at once. When scabs are formed they should be removed, and the exposed surface dressed with some stimulant.

A pustule is a small collection of pus under the epidermis, and generally seated in the substance of the true skin. ‘The inflammation, on which the formation of pus depends, extends some depth into the cutis, so that the collection of pus which constitutes the pustule is situated in the cutis, and not merely on it immediately beneath the cuticle.’ Pustules are divided into three sorts, viz. *psudraciæ*, in which the pustule forms in a hair-follicle, and the hair is seen passing through the pustule, the skin around being inflamed; *phlyzaciæ*, which are rather large collections of pus seated on inflamed bases, which burst and form thin brown scales; and *achores*, which are small pustules, usually in considerable numbers, with much redness of the intervening skin. Their secretion dries up into thick yellow crusts like dried honey. They are formed by the inflammation of the hair and sebaceous follicles. Pustulæ.

Impetigo and ecthyma are the only diseases which are to be described here. Equinia and variola are added in the formal classifications, but the former is a special lesion treated of elsewhere (p. 84), and the latter is not properly a skin-disease.

Impetigo is almost as common a disease as eczema. It is characterised by a copious eruption of pustules, both *psudraciæ* and *achores*, and by the thick honey-like crusts which they leave, as well as by the glandular enlargement which always (according to Sir W. Jenner) accompanies the eruption. The seat of the suppuration is in the hair-follicles, at any rate in the great majority of cases; though in some instances impetigo may be found in places Impetigo.

Eczema
impetiginodes.

where there is no hair, as beneath the nails.¹ The connection between eczema and impetigo is a very close one. True impetigo often follows eczema, and often also a mixture of the two eruptions is met with; the vesicles of eczema either suppurating rapidly, or being mixed in places with the pustules of impetigo. To this form of eruption the name eczema impetiginodes is properly applied.

Impetigo is divided into a great number of species derived either from its seat (*I. capitis*, *faciei*, &c.) ; from the arrangement of the pustules—*I. sparsa*, *I. figurata*, where the pustules are approximated on a defined patch of inflamed skin ; from the nature of the crusts left—*I. larvalis*, when the face is covered by a thick crust like a mask ; *I. scabida*, an obstinate affection seen in the lower limbs of adults, and often combined with anasarca ; *I. granulata*, when the crust, after separating from the skin, remains attached as a small lump to the hair ; or from the course of the disease—*I. acuta*, *I. chronica*. These are only some of the many subdivisions which have been made of this eruption. Impetigo is in some measure contagious, i.e. the disease may be implanted by means of the pus from the pustules or crusts. Thus it may be transferred from one child to another by wearing the same cap. Its contagion, however, is conveyed by actual contact, not through the air, as a fungus may be carried.

Porrigio.

Impetigo capitis, one of the most common varieties of the disease, is still sometimes called Porrigio—a term used by Willan and Bateman in a somewhat indefinite manner. It is well, therefore, to explain that, as Sir W. Jenner says, ‘Willan figures six varieties of his genus porrigio ; of these, *P. larvalis* and *P. favosa* are merely varieties of impetigo. *P. furfurans* is a species of eczema, *P. scutulata* is *tinea tonsurans*. *P. lupinosa* is *tinea favosa*, and *P. decalvans* is *tinea decalvans*.’ But that Willan’s description is not absolutely clear may be inferred from the fact that other recent writers interpret these terms somewhat differently.

Syphilitic
impetigo.

Impetigo occurs as a syphilitic eruption, but is not a common one, and usually in persons whose general health is bad. It is remarkable for the large extent of its patches, and is usually mixed with syphilitic tubercle.

Other causes of impetigo are the irritation of the hands by sugar—‘grocers’ itch’—the irritation of dirt or stone-grit ; and of lice in the head. Equinia is only a variety of this local impetigo.

The distinctive characters between impetigo and sycosis are given below (p. 917). From ecthyma it may be distinguished by the smaller size of the pustules in impetigo, and by their having no base ; from favus, by the absence of any parasite ; from eczema, by the implication of the hair-follicles.

Its treatment should be to cut the hair off as completely as possible and remove the crusts by poulticing, and then apply some slightly stimulating ointment—‘*ung. zinci*, *ung. hydr. nitratis*, *ung. hydr. nitr. oxydi*, *ung. sulph. iod.*, and *ung. sulph. hypochlor.* are all occasionally useful, and one will sometimes answer when the others have failed, and without the reason being apparent.’

But combined with this local treatment must be general regimen and medicine appropriate to the individual case. Alteratives and tonics are almost always required, quinine being the most useful. Change of air, sulphurous waters, and sulphur baths—especially when the disease is syphilitic—are often of great service.

Ecthyma.

Ecthyma is a disease difficult to distinguish from the early stage of rupia.

¹ See Nayler, *op. cit.* p. 170.

if indeed there be any distinction. Many authors (e.g. Mr. Nayler) include the two eruptions in a common description; others, as Dr. Bristowe, regard ecthyma as being another form of impetigo. Ecthyma consists in an eruption of large phlyzacious pustules on a red, elevated, and indurated base, which burst and leave a brown scab. When this separates a red inflamed portion of cutis, or a small ulcer, is left. The pustules and crusts are never so large as those of rupia are, nor do the latter assume the prominent adherent shape of rupia. It is a cachectic affection, frequently depending on syphilis; often preceded by burning pain in the part from which the pustules afterwards spring. The usual duration of the disease, when due simply to depression of the general health, is only about a fortnight; but it is apt to recur or to propagate itself in the form of a constant succession of crops of pustules, and so becomes chronic. In the variety which is complicated with purpura (*E. luridum*), the pustules are surrounded with an areola of a purple colour, in consequence of hæmorrhage. The eruptions which follow on the irritation of tartar emetic or sugar applied to the skin are variously classed as impetigo or ecthyma, according as the affection of the hair follicle is or is not regarded by the classifier as an essential character of impetigo.

Little local treatment is required in ecthyma. The crusts should not be detached, as they protect the skin below. The part should be defended from friction or irritation by some simple ointment, and the same general treatment pursued as in rupia.

A papule, or pimple, is an elevation of the cutis covered by its cuticle; the elevation being due to effusion of inflammatory lymph into the substance of the true skin. Papulæ.

A pimple differs from a vesicle not so much in its cause as in its extent of development. Both are due to inflammatory effusion in the substance of the skin: when this effusion separates the epidermis from the cutis a vesicle results; when it is confined to the substance of the cutis the result is a papule. Hence some excellent dermatologists (among whom I may refer to Dr. Bristowe¹) consider all the following papular eruptions as only different forms of the same disease as eczema.

The diseases classed as papular are strophulus, lichen, and prurigo.

Strophulus, the common 'red-gum,' is a disease of infancy characterised by the eruption of small pimples, usually red, and close together, *S. confertus*—sometimes white and rather large, *S. candidus*²—sometimes with red spots intermixed, *S. intertinctus*. The eruption is generally due to disorder of the bowels or irritation about the gums, and is accompanied by slight itching in most cases; sometimes, in *S. confertus*, by a good deal of distress from irritation and cracking of the skin. It will in most cases subside in a few days with some aperient, and attention to the state of the gums and of the digestion. Care should be taken not to confound this fugacious affection with the permanent lichen of congenital syphilis (see p. 414), and not to mistake flea-bites or irritation of the skin from dirt for strophulus. Strophulus

Lichen is characterised by the eruption of a large number of red prominent hard papules which retain their shape, and to a great extent their colour, Lichen.

¹ See the chapter on Diseases of the Skin, in Bristowe's 'Theory and Practice of Medicine.'

² There is an eruption of larger white papules called *S. albidus*, which, however, has been shown to be a form of acne, the elevations being really distended sebaceous follicles.

Syphilitic
lichen.

under pressure. There is often some itching and tingling about the part, and occasionally so much febrile disturbance that it is taken for an attack of measles. It is sometimes mixed with urticaria (*L. urticatus*), the papules becoming apparent as the wheals subside. It is a frequent syphilitic eruption, generally in the earlier stages of the constitutional affection, often becoming tubercular in its progress. Syphilitic lichen is known by its coppery colour, its appearance in curved figures (*L. gyratus*), its occasional presence on the soles of the feet, especially in infants, its tendency to crack at the base, and the history or concomitant symptoms of syphilis.

Other forms of lichen are the *L. tropicus*, or 'prickly heat,' a familiar disease in hot countries, and often seen here in hot summers, though in a milder form; *L. circumscriptus*, where the pimples appear in defined patches; *L. pilaris*, where each papule is found on a hair follicle, and has a hair running through it; *L. agrius*, characterised by the numerous hard rough pimples, generally on the face, where the skin feels like a nutmeg-grater, and by the excessive itching; *L. lividus*, a step between lichen and purpura, where the pimples are dusky red or livid, and purpuric spots may be interspersed, showing much cachexia and generally occurring in old broken-down patients; and, finally, the *L. ruber* of Hebra, in which large portions of the skin become inflamed and thickened, with a copious eruption of dark red papules on it, the thickening of the skin impeding motion, and the disease generally running on to a fatal termination.

Simple cases of lichen will be cured by purgatives, the avoidance of all sources of heat, simple unstimulating diet, and tepid or cold bathing, mucilaginous baths being most to be recommended. In the chronic forms arsenic (as in other dry eruptions) is of the greatest service. The syphilitic variety is under the control of mercury, and Mr. Nayler regards mercury in small doses as being of service in all forms of lichen. The itching is allayed by sponging the parts with vinegar or lemon-juice, and anointing them with dilute citrine ointment, or by a prussic acid lotion—3jss. or ʒij. of the dilute acid to six ounces of almond emulsion, or of rose-water to which a drachm of liq. potassæ may be added.

Prurigo.

Prurigo is an eruption characterised by its itching, and by the presence of flattened papules so much the colour of the skin as to be with difficulty perceived in some cases. The itching is increased by any stimulant or by heat, so that it often becomes intolerable in bed. Prurigo is often mixed with urticaria. Sometimes there is a sensation as of insects crawling over the skin, *P. formicans*. Old persons suffer from prurigo, which is then called *P. senilis*, and is often very obstinate. In younger subjects it usually disappears in a short time. There is no doubt that in many cases the complaint is caused by the presence of lice, and such cases may be cured at once by destroying or baking the clothes, and by free bathing and the application of the white precipitate ointment. There are other cases in which the prurigo is local, usually about the genitals or anus—*P. podicis*, *vulvæ*, *scroti*, &c. In these cases the designation is usually a misnomer. The disease should be called pruritus, for there is intolerable itching, so that the patient is sometimes withdrawn from society by the impossibility of abstaining from scratching the part, but no pimples can be seen. Prurigo, or pruritus, is also sometimes a sequela of another eruption, i.e. intolerable itching in the part is left after the previous eruption has disappeared. This is most common after eczema and scabies.

The first principles of treatment in prurigo are precisely similar to those in lichen. The patient's bowels must be cleared, his digestion regulated, and all

causes of heat and irritation avoided. In pruritus ani, vulvæ, &c., any unnatural condition which can be detected must be remedied. The former sometimes depends on ascarides, or on fissure; the latter on the presence of a vascular tumour of the meatus, or on the habit of self-abuse. The most various local applications are in use and appear of advantage; of these the mercurial lotions and ointments, or lotions of sulphuret of potassium, sulphur baths and ointments, and prussic acid lotions have the greatest reputation. Whatever is found best to allay the itching should be kept at hand for immediate application when the patient becomes warm in bed, and he should abstain as much as possible from scratching.

Squamæ, or scales, are collections of dry epithelium, loosely connected to the subjacent skin, so that they may be easily rubbed off. Squamæ.

The squamous diseases are pityriasis and psoriasis. One form of pityriasis due to the presence of a parasite has already been spoken of as *chloasma*. Pityriasis The characteristic of pityriasis is the smallness of the scales, like those of bran, and the ease with which in most cases they fall off. The common pityriasis, or dandriff of the scalp, is the most familiar example of the disease. Pityriasis is also often produced by drying the skin imperfectly after washing and then exposing it to the sun or wind. In these cases the skin is often a good deal reddened, and the disease is then called *P. rubra*. Pityriasis has the closest relation to roseola, and is regarded by Dr. Bristowe as merely the desquamative stage of that eruption.

In the treatment of pityriasis the object is to slightly astringe the vessels of the skin and soften the epidermis, protecting the part from any irritation by some mild ointment. Borax is the lotion generally used, and diluted white precipitate ointment. The hair ought to be cut short and very gently brushed, and if it falls out (as is very common), a liniment of equal parts of acetum cantharidis and spirit of rosemary may be applied. Any derangement of health or digestion must be at the same time attended to. The hair may always be expected to grow again.

Psoriasis is an exceedingly common disease, both without and with syphilis. It is characterised by shining white scales situated on slightly inflamed portions of skin. In the ordinary non-syphilitic psoriasis these patches have no definite figure: they are situated mainly on the coarser parts of the skin, chiefly on the outer sides of the limbs, the elbows, and the knees. Another form is called *P. guttata*, in which the patches are very small and seem as it were to have been dropped or dredged on the skin. When the affected portions of skin assumed a circular form the disease used to be called *lepra*; by others this appellation is reserved for syphilitic psoriasis, which, like other syphilitic eruptions, is prone to assume a circular or curved shape, and which does not show any such preference for one over the other aspect of the limbs as *P. vulgaris* does. Psoriasis.

Lepra.
Syphilitic
psoriasis.

The other varieties of psoriasis are of less importance. When very extensive it is called 'diffusa'; when peculiarly obstinate, 'inveterata,' &c. Psoriasis is often an accompaniment of struma, and is habitual with some persons, who suffer from it regularly at intervals.

The syphilitic variety requires mercury in some form. It is a secondary eruption in most cases, and is usually rapidly cured by fumigation. In non-syphilitic cases the great remedy is arsenic, which should be pushed till the characteristic effects of the poison begin to be manifested, or arsenic may be exhibited in combination with mercury, as in Donovan's solution. In cases

which are not cured by arsenic, cantharides or pil. picis may be tried, and copaiba is said sometimes to succeed. Tar in some form is the best local application, as the unguentum picis or the Barbadoes tar. Sulphur-baths and vapour-baths are also often useful.

Tuber-
culata.

Tubercles are pimples on a larger scale, i.e. solid hard elevations of the cutis.

The tuberculous diseases are of the most varied clinical characters. They are acne, lupus, molluscum, elephantiasis, frambæsia, and keloid. Cancer is sometimes added, which, indeed, forms tubercles in the skin in some rare cases, but cannot properly be classed as a skin-disease.

Acne.

In acne the tubercles are caused by obstruction of the sebaceous follicles and effusion into the skin around them. Suppuration often occurs at the apex of the tubercle, constituting acne simplex vel punctata, so frequently seen on the neck, face, and shoulders, intermixed with black points, which are the orifices of the sebaceous follicles, from which a worm-like mass of secretion may be pressed, which is popularly regarded as a parasitic animal, and which does often contain a microscopic parasite, the *acarus folliculorum*.

In acne indurata the hardening and thickening around the tubercles is greater, the tubercles coalesce, causing great deformity, and there is little tendency to suppuration.

Acne rosacea is chiefly seen on the nose and parts adjacent, and has been spoken of on p. 639.

Acne sebacea is a rare form of acne, characterised by a superabundance of the sebaceous secretion, which sometimes covers the skin, dries upon it, and turns hard and black, constituting what is called (not very accurately) spurious or sebaceous ichthyosis.

The treatment of acne is in great measure local, consisting in opening the sebaceous follicles by bathing and friction, pressing out the secretion from them, and puncturing the tubercles which have suppured. The tubercles may be lightly touched with acid nitrate of mercury or strong nitric acid. Lotions of bismuth and mercury, or mercurial and sulphur ointments, may then be useful as permanent applications.

At the same time much care must be used in regulating the diet, correcting any excesses in it, and forbidding the use altogether of anything which can promote acidity.

Syphilitic
acne, or
syphilitic
tubercle.

The term syphilitic acne used to be applied to the tubercular eruption so often seen on the face in the later stages of secondary syphilis, but incorrectly if the word acne is restricted to an affection of the sebaceous follicles. The colour of the eruption, its dense arrangement over the face, and the presence of other syphilitic symptoms sufficiently mark its nature. There is not the tendency to suppuration which is seen in true acne, and a mercurial course is generally followed by its rapid subsidence.

Mollus-
cum.

Molluscum is a singular disease, seen usually in children, in which there is a crop of large tubercles, frequently of a dead white or of the natural colour of the skin, many of them presenting a dark point with a depression, and regarded as being obstructed sebaceous follicles, others having no such depression. Molluscum is regarded by many authors as contagious, and Hardy teaches that a cryptogamic plant is to be found in it, but others doubt that the eruption possesses any such property. The only treatment required is to lay the tubercles open and rub their interior with caustic, or to snip them off. There is no constitutional affection.

Mr. Pollock has lately communicated to the profession two cases of a very peculiar affection in women, bearing some resemblance to molluscum, in which large pendulous fibro-fatty masses occupied a great part of the neck, chest, and other portions of the body. These are now usually known as 'Molluscum fibrosum' (see p. 354). In one of these cases much benefit



FIG. 400. Drawing from a patient who was under my care at St. George's Hospital, showing a combination of Molluscum fibrosum with common naevus. *a, a*, show the molluscous growths. The upper one is of considerable size and a portion of it is semi-pendulous; the lower is only a small tubercle, situated in the centre of a large congenital stain of naevus, indicated by the letters *b, b*.

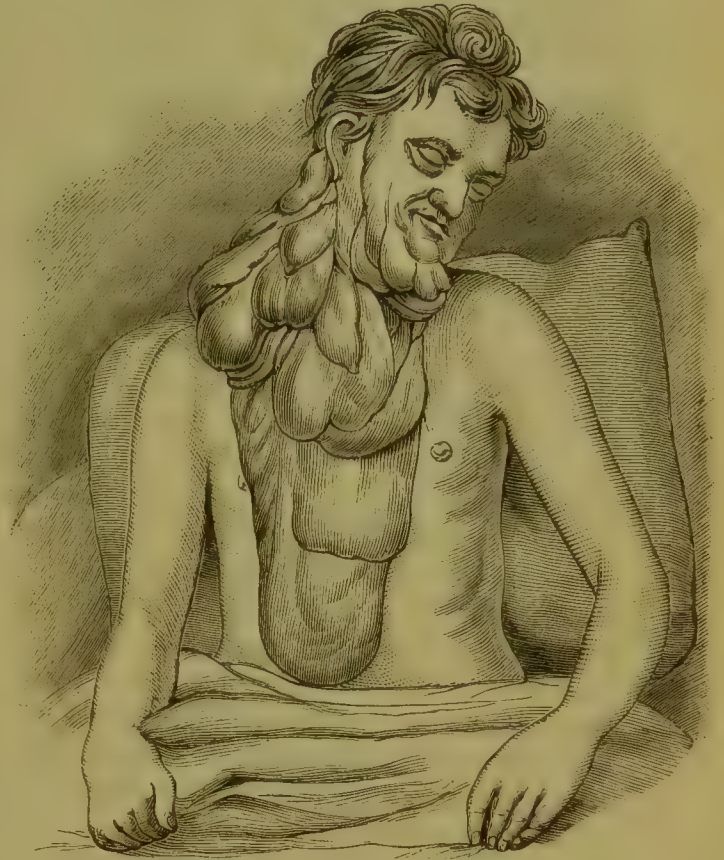


FIG. 401. Molluscum fibrosum.—From a drawing in the Museum of St. George's Hospital.

followed on the removal of some of the largest of these pendulous masses; in the other case the patient died from the effects of the operation.¹

Under the term 'Lupus' are described two different diseases which have but little in common. These are Lupus erythematosus and Lupus vulgaris.

The former of these, Lupus erythematosus, may be defined as a hyperæmia of the skin, mainly affecting the sebaceous glands and hair-follicles, and accompanied by a cell growth. The disease begins with an active congestion of the capillary plexuses around the sebaceous glands and hair-follicles, attended with inflammatory exudation and round-celled infiltration of the tissues around them. In the earlier stage of the disease the sebaceous secretion is increased in quantity and the acini of the gland dilated; but later on the glands become destroyed and replaced by the round cells, which in their turn become developed into cicatricial tissue.

The disease commences usually in early adult life, as a bright red patch, on any part of the body, but principally on the face—the side of the nose or cheek. The patches are sharply defined, and speedily become covered with

¹ See 'Med.-Chir. Trans.' vol. lvi., and 'Path. Trans.' vol. xxvi.

an adherent crust, which is attached by plugs of sebaceous matter extending into the dilated ducts, and which may be drawn out on removing the crust. As the disease advances at its circumference, the central parts become pale and shrunken and present a cicatricial appearance, so that soon the disease presents the appearance of a central depressed scar, with a bright red raised margin. There is never any ulceration, but as the cicatricial tissue in the centre increases in extent, it contracts and produces great puckering of the features and deformity. Its etiology is unknown, it has never been connected with a scrofulous or syphilitic diathesis, and is not known to be hereditary or contagious. Many local applications have been recommended for this disease, but so far the results have not been encouraging. Mercurial ointment, iodine, carbolic acid, caustics, such as acid nitrate of mercury, linear scarification, scraping with Volkmann's spoon, have all been tried, and in some cases no doubt with benefit, but in others the results obtained have not been encouraging. In some instances attention to the general health and removal of all sources of local irritation, with the application of some mild stimulating ointments, has been apparently more efficacious than more potent remedies. In one or two cases I have found a very good result follow the application of white precipitate ointment combined with a small amount of carbolic acid, together with attention to the general health.

Lupus
vulgaris.

The other form of lupus—'lupus vulgaris,' or simply 'lupus,' as it is sometimes called—is a disease of the skin and mucous surfaces, attended by the formation of a cellular new growth. By some pathologists it is regarded as a tuberculosis of the skin, inasmuch as in this cellular new growth, non-vascular nodules consisting of a central giant cell surrounded by epithelioid cells and beyond these by small round cells, i.e. nodules of grey granulations, are generally to be found. And, indeed, Schüller and others have asserted that they have found the tubercle bacillus in this tissue, and Schüller has produced tuberculosis in animals by inoculation of lupous tissue. The disease begins in the deeper layers of the corium, with a dilatation of the vessels, attended by a round-celled infiltration of the tissues. The cells are arranged in spherical nodules, which increase in size and, coalescing, form large masses of cells which gradually absorb and replace the normal structures of the part, until the whole thickness of the true skin is destroyed from the epidermis to the subcutaneous tissue; the epidermis itself becoming thickened, but otherwise undergoing no change. When the process is completed and the whole thickness of the skin destroyed, one of two changes may occur: either the round cells of which the new growth consists, and which must be regarded as analogous to the ordinary round cells of granulation tissue, may undergo conversion into cicatricial tissue, and a scar be formed without ulceration. This scar then undergoes the ordinary contraction peculiar to scar-tissue, and, puckering in the features, often produces a most distressing deformity. This is the non-ulcerative form of lupus—'lupus non-exedens,' as it is sometimes called. In other cases the cells, instead of undergoing this developmental change, may pass into a state of fatty degeneration and the whole growth caseate, soften, and become converted into a disintegrated mass, which is discharged, leaving a foul, ragged ulcer, which slowly extends. This is the ulcerative form of lupus—'lupus exedens.' The ulcer thus formed may, under treatment, cicatrise, forming a scar which produces deformity, as in the non-ulcerative form.

Lupus commences as one or more tubercles in the skin, most frequently at the side of the nose. These tubercles are brownish red, retaining their

colour on pressure and having a semi-transparent appearance. They have been most aptly compared to 'apple-jelly,' to which they bear a striking resemblance. The nodules increase slowly; if there is more than one, after a time they coalesce and form a large mass, elevated above, but incorporated in the skin and covered over by its epithelium, which shows a tendency to desquamate. After the growth has attained a certain size, if it is going to take on the non-ulcerative form it begins to contract and disappear, and is finally replaced by a dense, white cicatrix, like that produced by a burn, or by a thinner red cicatrix, either of which may be surrounded by an 'apple-jelly' ridge of progressing disease. In the ulcerative form of the disease the mass softens and eventually bursts, discharging a caseous material and leaving a sharply defined ulcer with slightly raised edges and an unhealthy surface. This ulcer may extend superficially over a considerable part of the face, producing a most hideous deformity.

The only treatment of lupus which appears to be reliable and on which dependence can be placed is the thorough removal of the disease. This is usually best done by scraping, though in some cases an isolated nodule may be removed by excision or destroyed by the actual cautery. In the majority of cases, however, thorough scraping with a sharp spoon until the whole of the diseased tissues have been removed and the healthy structures exposed will yield the best results. It is wise after this scraping to apply to the exposed surface some caustic, of which, perhaps, a solution of chloride of zinc (gr. xl. to ʒj.) is the best, in order that any particles of diseased tissue which have escaped the spoon may be destroyed. In a large number of cases, however, in spite of the most complete extirpation, a recurrence will take place. Some surgeons speak of the beneficial effects in the non-exedent form, of scarification, i.e. a number of superficial incisions, or scorings, drawn from healthy tissue on one side of the diseased surface to the other, and then crossed by others at right angles to them. As regards constitutional treatment, all that is necessary is to keep the patient's general health in as perfect a condition as possible, by attention to hygienic and dietetic conditions and the administration of tonics.

Elephantiasis is a name applied in common to two very different diseases, distinguished from each other as *E. Græcorum*, the tubercular leprosy, and *E. Arabum*, or Barbadoes leg. Elephantiasis.

The former is an endemic disease which is at present unknown, or nearly so, in these islands, though it seems that it used to prevail here, and it is still prevalent on the Baltic coast; but its more favourite seat is in hot countries. It is more common in males than females, and is rarely seen till after puberty. It occurs in two forms, the anæsthetic and the tubercular. In the former the skin loses its sensibility in patches, the affected parts soon ulcerate, the fingers and toes shrivel and drop off, and the patient usually dies from some exhausting disease, as diarrhœa or dysentery. In the other form, after more or less pain in the part and disturbance of health, irregular discoloured patches of skin are seen, which become covered with small tubercles, the face, palate, eyes, and larynx are affected, and ulcerate; and the patient usually sinks gradually, or dies suddenly from laryngeal symptoms. The cause of the malady is unknown, nor does any treatment appear of use. The disease is plainly proved not to be contagious. Dr. Vandyke Carter has published (in the 'Transactions of the Med. and Phys. Soc. of Bombay,' and in vols. xiii., xiv. of those of the Path. Soc.) some very interesting researches showing the atrophied condition of the sensory nerves Leprosy.

in leprosy. As the disease is not seen in this country, and is more a medical than a surgical affection, it is unnecessary to dwell on it here.

Elephan-
tiasis
Arabum.

The elephantiasis which we are called upon to treat surgically in this country is that which is called *E. Arabum*, or Barbadoes leg. It occurs in the lower extremity or in the genitals, and no doubt originates spontaneously in this country, though it is not prevalent to any extent—in fact, is rare, apart from some cause of obstructed circulation. In the leg the limb swells enormously, mainly from hypertrophy of the cellular tissue; the skin becomes hard, thick, and warty, and in some cases distinct tubercles are developed upon it. It cracks and ulcerates, and sometimes the toes drop off. In many cases (at least in the tropical disease) there are intermittent attacks of fever, and in the opinion of some experienced practitioners the disease owns a malarious origin, but the generally received opinion is that it is excited by the presence of a minute animal, the *Filaria sanguinis hominis*, which blocks up the lymphatics and excites the inflammation. The treatment of elephantiasis, as far as I have seen, has not been very successful. The size of the limb may be much reduced, especially in recent cases, by careful pressure with the elastic bandage and the application of mercurial lotions and ointments, or by iodine, with the administration of biniodide of mercury in small doses, but I believe that the disease generally, if not always, reappears. Electricity has also been found useful in some cases. The ligature of the main artery of the limb was practised by Dr. Carnochan, of New York, and spoken of at first as universally successful; but since its more extended trial in this country, it has been so clearly shown that the benefit which follows the operation is in most cases but temporary as to render it probable that it always is so, and that the operation ought only to be considered in the light of an experiment, which failing, amputation of the limb is indicated. Considered in that light, it may be justifiable to tie the femoral artery. Failing this, when the enlargement makes the patient's life intolerable, it must be removed, whether the leg, the scrotum, or the vulva and labia are the seat of the disease (see p. 868).

Keloid.

Keloid tumours, as usually seen, are developed in scars; and I have spoken of them on a former page (see p. 427). Dr. Addison has applied the same name to a condition which he calls 'true keloid,' but which is perfectly different from the flattened tumours (like gigantic tubercles) which arise from the cicatrices of burns, floggings, and other extensive and slowly healing injuries. Addison's keloid is not a tumour at all, but a patch of hidebound skin in which the skin, fascia, and muscles are adherent together, and the surface is yellowish and covered with scales. I am not aware that treatment has any effect on this condition.

Frambæ-
sia.

Of frambæsia, or yaws, I will merely say that it is a highly contagious eruption of red tubercles, soon ulcerating, which affects chiefly the negroes in the West Indies, but has been seen in remote parts of Scotland and Ireland.

Maculæ.

I need only enumerate the maculæ, or permanent stainings of the skin. None of these affections come under the treatment of the surgeon; and, in fact, they are hardly under the dominion of any treatment. They are the 'bronzing' of the skin connected with the degeneration of the supra-renal capsules found in Addison's disease; the 'moles,' or congenital deposits of pigment, which are so often found covered with hair, and which are liable occasionally to degenerate into melanosis; the 'silver-stain,' or lividity of the surface, which is found in persons who have taken nitrate of silver internally

for a long time; and the want of pigment which, when universal, is called '*albinism*,' and when localised in patches '*vitiligo*.'

The diseases excited on the skin by the growth of a vegetable parasite are tinea tonsurans, tinea decalvans (possibly), tinea favosa, tinea sycosis or simply sycosis (mentagra), and chloasma or pityriasis versicolor. Parasitæ.

Tinea tonsurans is exceedingly like herpes circinnatus; so much so that by some they are classed as the same disease, and both are included in the popular term 'ringworm.' It is seated on the hairy scalp, and is only seen in children, seldom before two or after twelve years of age. It appears in round patches covered with white scales, and here the hairs are so completely removed that the places seem to have been shaved; but on minute examination, short thick twisted hairs will be found among the scales, and the hair-follicles can be detected, and after its cure the hairs will always grow again. The disease is caused by the growth in the hair of a vegetable parasite—the trichophyton tonsurans.¹ This embeds itself in the secretion of the hair-follicles which is believed to be unhealthy, and as it grows into the hair it causes it to swell and become brittle, so that it breaks off and comes away. The spores of this plant may be found also in the epithelium of the patch, which is heaped up in opaque white scales. Tinea tonsurans.

The treatment is directed to the destruction of the parasite. Strict cleanliness must be enforced, the epithelium removed by a lotion of borax, and an ointment rubbed in twice a day to destroy all the spores of the fungus. Sir W. Jenner recommends 5 grains of the ammonio-chloride of mercury to the drachm of sulphur ointment for this purpose; or 2 grains of the perchloride to the drachm of lard; or 30 grains of nitrate of copper to 4 drachms of lard; or 10 drops of creosote to the drachm of lard; or strong blistering fluid or strong sulphuric acid, the part to be washed directly afterwards with cold water.

In so-called tinea decalvans the hairs are completely removed from the scalp, and sometimes from other hairy parts also, in large irregular patches, where the skin is perfectly bald with no trace of the truncated hairs which are found in tinea tonsurans. The skin exposed is smooth and paler than natural. This is said to be due also to the presence of a parasite—the microsporon Audouini—which, however, Sir W. Jenner says he has never been able to find either on or in the hairs about to fall from their follicles, nor has Mr. Nayler been more successful in his search for these sporules.² There is also no proof that the disease is contagious as parasitic diseases always are; accordingly in this country the disease is more frequently classed as '*Alopecia*.'³ The bald patches are bounded by definite margins, and as these areas fall into each other the whole scalp may become bald; nay, I have seen a case in which the whole body was so, no trace of a hair being recognisable on any part. Alopecia is also a common symptom of syphilis, especially common in the secondary syphilis of young girls and in congenital or acquired syphilis in infants. The remedies consist in the application of stimulants to the part. The bald patches should be painted about once a fortnight with blistering Tinea decalvans, or Alopecia circumscripta vel areata.

¹ I must refer the reader to some of the special treatises—such as that of Mr. Nayler—for the microscopical appearances of these parasitic fungi. In the judgment of some dermatologists, as Dr. Tilbury Fox, they are all different stages of growth of the same plant.

² '*Diseases of the Skin*,' 2nd ed. p. 216.

³ Dr. Bristowe (3rd ed. of '*Syst. of Surg.*') describes this affection, under the name of '*Porrigio decalvans*,' as a disease of the hairs. Alopecia syphilitica.

fluid, and left alone till the irritation has subsided, when a slightly stimulating ointment or lotion is to be applied till the time for the next blistering arrives. Liniments or lotions of ammonia seem well suited for this purpose (see p. 409). In syphilitic cases a mercurial course is indispensable. Slight cases, especially at early periods of life, and syphilitic cases, will probably get well; in very extensive alopecia, and in older persons, there is much reason to fear that the baldness will be permanent.

*Tinea
favosa, or
favus.*

Tinea favosa, or *favus*, is a very acute and formidable eruption of the scalp in childhood. It is due to the lodgment in the hair-follicles of the sporules of a fungus called the *achorion Schönleini*. These give rise to an eruption consisting of brimstone-yellow crusts, cup-shaped, and each having a hair in its centre. These dry crusts are not uncommonly mixed with pustules of *impetigo*. As these crusts increase they kill the hair on which they form, and thus *favus*, unless soon cured, may induce permanent baldness of the affected part. In some cases a peculiar and unpleasant odour is perceived (compared to that of cat's urine), but not always. Sir W. Jenner has noted that children affected with *herpes circinnatus* are peculiarly exposed to the contagion of *favus*, and has given interesting examples of this fact.

The cure of *favus*, as of other parasitic diseases, is procured by killing the parasite. For this purpose the hairs may be plucked out. The *huile de cade* is said to loosen their attachment, and the hairs have less than the normal tenacity of implantation in any case, so that when the disease is limited there is no great difficulty; but it becomes almost impracticable when the scalp is extensively affected. No doubt drawing out the hairs facilitates the application of the parasiticide remedies, but Mr. Nayler says that it is by no means necessary, and that after the usual preparatory cleansing, tar, or the *ung. picis liquidæ*, answers every purpose. In fact, these applications as they separate bring away the hairs with them. Then a saturated solution of sulphurous acid applied on lint covered with oiled silk, or perchloride of mercury in the proportion of 8 grs. to the ounce of lard, or acetate of copper, half a drachm to the ounce, are recommended for the destruction of the parasite. *Favus* affects the hairs of other parts of the body as well as the scalp. It is a rare disease, and only seen in the poorest and most neglected children. It is undoubtedly contagious, though not very actively so (see Nayler, *op. cit.* p. 245).

*Tinea
sycosis, or
mentagra.*

Sycosis is a disease of the beard and whiskers, very rarely of any other part, though Mr. Nayler refers to cases in which the eyebrows or the hair of the back of the neck have been affected, and I believe cases have been recorded in the female. It is due to the lodgment of a parasite—the *microsporon mentagraphytes*—in the hair follicle, the presence of which excites an inflammatory swelling of the follicle, like that of the sebaceous follicle in *acne*, followed by suppuration. A hair is seen to traverse each pustule, which would sufficiently distinguish it from *acne*, to which otherwise it bears a considerable resemblance, as it does to *impetigo*; but in *sycosis* there is much more thickening around the pustules than in *impetigo*.

Sycosis is often very difficult to cure. The patients are frequently out of health, either from intemperance or starvation, so that the first thing is to correct either of these excesses, to bring the patient's digestion into good order, and supply him with a generous unstimulating diet. The scabs must be removed by poulticing, the hairs removed if possible, and some of the parasiticide ointments above prescribed applied. Iodide of sulphur ointment and white precipitate ointment are the favourite applications, but if the eruption does not yield to one, another must be tried.

Another undoubtedly parasitic disease is the one so often seen on the chest and loins,¹ especially in young people of delicate skin and in others who neglect cleanliness, and especially who constantly wear the same unwashed flannel. The eruption, however, though favoured by such dirty habits, does not arise exclusively from them, for in some cases persons of scrupulous cleanliness are found to be affected. It never occurs in childhood. It is characterised by the presence of numerous circular brownish patches ('chloasma'), which, however, vary in shade from yellow to dark brown, or even a reddish tinge, in different persons, and in the same person at different times, whence its synonym, 'pityriasis versicolor.' The patches consist of epithelium which is bran-like and desquamating, and if these scales be removed and examined in an alkaline fluid or, as Mr. Nayler recommends, in acetic acid, abundant spores and mycelium of the fungus—microsporon furfurans—will be detected.

Chloasma
or pity-
riasis versi-
color.

The complaint is a very common one, and is consistent with the most perfect health—the only inconvenience the patient experiences being that his skin is irritable when he gets hot.

It is to be diagnosed from 'liver-spot' (lentigo hepatica), a very rare disease, which has no scaling of the epidermis and no parasitic origin, and which occurs in childhood as well as in after life—and also from the other kinds of pityriasis presently to be described.

Its cure must be sought, as before, in the destruction of the parasite, for which purpose all dirty habits must be reformed, the skin well rubbed, after thorough washing, with a flesh-brush daily, and then sulphur ointment or a lotion or ointment of bichloride of mercury will cure the disease, though it is very liable to recur. Like other parasitic diseases it is contagious.

The only parasitic animal which causes an eruption is the *acarus scabiei* or *sarcoptes hominis*, which burrows and hides itself in the deeper layers of the epidermis, and thus gives rise to an irritation which develops a definite eruption—'the itch'—of either a vesicular or pustular nature. The intolerable itching excites the patient to scratch himself, and thus much aggravates the eruption.

Scabies.

Scabies is seen first in the adult usually in the hands and wrist, especially in the clefts between the fingers; in children in arms on the buttocks. It is known by the itching and scratching and by the vesicles or phlyzacious pustules mixed with small cracks or burrows leading from the bases of some of the vesicles, and marking the spot where the animal may be found if the burrow be carefully opened with a needle and searched with a magnifying-glass.

The remedy for scabies is sulphur, which never fails to kill the animal, if only the disease is not excited by fresh parasites from the clothes. If these are fumigated with sulphur or baked for a sufficient time, and all parts affected with the eruption smeared well over with the ung. sulphuris twice a day, the patient will be well in a few days. Sir W. Jenner says that at the St. Louis Hospital at Paris a cure is obtained in two hours by the patient being well rubbed over with soft soap for half an hour, then smeared with an ointment composed of eight parts of lard, two of sulphur, and one of carbonate of potash for half an hour, and then placed in an alkaline bath.

If there is any objection to the colour or odour of the sulphur, the former may be concealed by the admixture of the bisulphuret of mercury, and the latter by a few drops of essence of bergamot.

¹ Other parts of the body are occasionally though rarely affected—the face very seldom.

Xero-
derma.
Ichthyosis.

The only other disease of the skin which I think it worth while to mention is the malformation which consists in the imperfect development or entire absence of the sweat glands and ducts, which produces the condition named ichthyosis, a condition characterised by the collection of dry scales over a part or the whole body; congenital in the worst cases, in others occurring in later life, as after the cessation of the catamenia. I merely mention the subject here in order to caution the reader not to confound pityriasis or psoriasis with this affection, which is, as Mr. Nayler says, rather a malformation than a disease of the skin, and which is sufficiently distinguished from those diseases by its history as well as by the appearance; for in ichthyosis it is not merely the scaly eruption, but also the thickening and dryness of the skin which constitute the morbid state.

Plica.
Polonica.

I must now turn to the affections of the appendages of the skin. The only distinct disease which affects the hair is plica Polonica—a matted state of the hair of the scalp, and in rarer cases of other parts of the body, met with in Poland and the neighbouring countries. The matted hairs are stuck together by a glutinous material in which foreign substances are found, and in old-standing cases a fungus. The exact nature of the affection is not known. Most authors now adopt Hebra's explanation that it is due to eczema or some other skin-affection long neglected.

Corns.

Corns are elevations of the epidermis formed by intermittent pressure, which acts as an irritant and produces inflammatory effusion. Continuous pressure, on the contrary, causes absorption. Corns are, for obvious reasons, usually found on the feet, though they may grow on any part which is irritated in a similar way, as on the fingers of tailors, musicians, or rowers; but it will be sufficient to speak of the ordinary corns of the feet. They are either hard or soft, the first being seated on the dorsum or more rarely the plantar aspect of the toes and feet, and consisting of thickened and heaped-up epidermis; the corn sometimes when it has lasted long producing absorption of the true skin, and then often having a bursa below it. They are peculiarly liable to form on toes deformed by the pressure of ill-fitting boots. They cause a good deal of pain in walking, and sometimes lead to more serious mischief, as to lateral curvature from the unequal use of the limbs. Or suppuration may occur in the bursa, or in the cellular tissue beneath the corn, and this may spread so deeply as to open the articulation or expose the bone below, and then may spread to the other surface of the foot, constituting one form of the 'mal perforant du pied' of French authors. Soft corns form between the toes, and bear a great resemblance to warts, consisting often of enlarged papillæ ensheathed by epidermis. They often grow to some size and then give rise to great annoyance, and they may inflame and suppurate as hard corns do. Another variety which also bears a certain resemblance to warts is the fibrous corn, sometimes seen on the sole of the foot, and formed of the papillæ of the skin covered with epidermis. These are often acutely painful, and from their position altogether hinder the patient from active exercise.

The treatment of corns in all their stages or forms must commence with correcting any defect in the boots and withdrawing the parts from pressure, which can be managed if necessary with a 'corn-plaister'—a piece of thick plaister with a hole in it to receive the corn. The hardened epidermis may be gradually rubbed down with glacial acetic acid or with nitrate of silver applied after the outer hard part of the corn has been pared, or with a corn-

file ; or the cuticle may be softened by the application of strong alkalies. The chiropodists cure corns by cautiously digging round the thickened epidermis till it can be turned out of the hole which it has formed in the cutis, which they call extracting the root of the corn. When suppuration forms beneath a corn the little abscess should be opened at once, and then the corn will often fall off altogether. When the corn forms on the back of a bent toe it cannot probably be cured till the toe is straightened. Soft corns may generally be cured by keeping the toes apart with a plug of cotton-wool and steeping the corns in acetic acid or dusting them with oxide of zinc, pure or mixed with pulv. æruginis.

Perforating disease of the foot is an affection but very rarely met with, and which has hitherto resisted all treatment except amputation. It commences as a small round sore, usually on the sole and near the metatarsophalangeal joints, but occasionally on the dorsum, though always I believe near the level of those joints. The origin of the disease seems certainly in many cases to be in a suppurating corn ; in others it seems to have some connection with a morbid state of the nerves, as the skin is noticed to have lost insensibility, and to sweat profusely, and in these (as probably in others not accompanied by anæsthesia) it has no connection with corns, commencing as an ordinary ulcer, preceded, as Nélaton teaches, by a phlyctæna. In other cases the disease is associated with some central degenerative nerve lesion, and is found to occur in patients who are the subject of locomotor ataxia. From its point of origin the disease extends, sometimes accompanied by severe pain, down to the metatarsal bones, which become necrosed, and thence to the tarsus, till at length the patient is fain to consent to the removal of the foot. This can be done by Pirogoff's or Syme's operation with every prospect of permanent relief. I have not, as yet, seen any other treatment of which I could confidently say that it had been permanently successful. In one case, however, I removed the outer portion of the metatarsus with the corresponding toes on both sides, and the wounds healed, and so long as I had the patient under observation she seemed cured. In an early stage of the disease, the free destruction of the ulcerating soft parts with caustics and the removal of all exposed bone are the most rational measures ; but they hold out little promise of success, especially in cases complicated with anæsthesia. The most complete account of this curious affection is to be found in Mr. Hancock's 'Lectures on the Anatomy and Surgery of the Human Foot,' pp. 57 *et seq.*, while the literature of the subject is summarised and the microscopic anatomy of the diseased nerves illustrated in the paper by Mr. Butlin and Mr. Savory in 'Med.-Chir. Trans.' vol. lxii.

Perforating
disease of
the foot.

Bunion has been spoken of on p. 529.

Warts are collections of hypertrophied papillæ covered with epithelium, and sometimes hardened on the surface by friction and exposure. They are situated very commonly on children's hands, and occasionally on other parts of the body. The verruca digita or branching wart, which forms sometimes on the scalp in women ; the sub-ungual warts which form below and at the side of the nails, and are very painful ; and the verruca confluens, in which a crop of small warts collect into a mass on the back of the hand or arm, or on the neck and thorax, so that the skin resembles coarse plush, are varieties which deserve special attention on account of the desirability of eradicating them at once.

Warts.

The warts which occur from venereal causes, and which are very common

Venereal
warts and
condylo-
mata.

on the female genitals, and to a less extent on the male, are due to the irritation of discharge retained in contact with the skin or mucous membrane. They often spread over a large surface and attain a considerable size. Those which are truly called warts consist of epithelium and papillæ only. The condylomata are masses often of very large size, consisting of all the structures of the skin hypertrophied, sometimes to an enormous extent, and covered with a copious warty growth.

Chimney-sweep's cancer is sometimes spoken of as a kind of wart produced by the irritation of soot, and certainly it commences with a warty or papillomatous growth on the surface of the skin; but at the time we generally see it the deposit of epithelioma extends far beyond the papillary structure.

No cause is known for the common warts. They appear and disappear in the most capricious manner. The venereal warts are no doubt contagious, and this is popularly believed of the common warts, and especially of the blood from them, but without any proved foundation. In some rare cases warts may become the seat of epithelial cancer, and they may in others prove the starting-point of horns, but usually they are merely a disfigurement. They may be removed by thoroughly soaking them in nitric acid or the acid nitrate of mercury or glacial acetic acid or perchloride of iron, or by repeated applications of stick-caustic. The venereal warts must be treated by scrupulous cleanliness, by the application of the strong liquor plumbi, and by a mercurial course if other secondary symptoms are present, or they may be removed. When large condylomatous masses exist it is necessary to remove them; and, since severe hæmorrhage may take place in such operations, it seems better to avoid the knife if possible, and effect their removal with the *écraseur* or the elastic ligature.

Horns.

Horns are occasionally seen growing from the surface of the body in various parts. They originate either in accumulated sebaceous secretion, or from overgrowth of the epithelium, or from overgrowth of the nails, or from the hardening and continued growth of a wart.¹

The whole horn must be removed, and if there is a sebaceous cyst at the bottom, this is also to be cut out.

Boils.

A common boil or furuncle is an inflammation of the skin and cellular tissue, limited to a very small extent, and containing in its interior a small slough of cellular tissue called the *core* of the boil. The inflammation attacks more especially the sebaceous follicles of the hair bulbs, and boils are therefore not found in parts where these structures are absent. Another kind of boil, called a 'blind boil,' is less defined or limited, and contains little if any core. The common boil increases in size and painfulness for a day or two, forming a red angry lump in the skin, and then bursts, and the core or slough presents at the opening. This is drawn out, or gradually makes its own way, and then the inflammation and swelling rapidly subside, and healing soon follows. In some cases the furuncular inflammation gradually subsides, and the patient recovers without any suppuration. This, however, is not often seen in acutely painful boils.

In blind boils, after some days of pain and inflammation, a vesicle or a superficial pustule forms, and then the hardening gradually recedes and finally disappears.

The causes of boils are very numerous. Locally they may be caused by

¹ See T. Smith and Godlee, in 'Syst. of Surg.' 3rd ed. vol. ii. p. 941.

dissecting-room poisons, and perhaps by other morbid matters applied to the skin; but in the great majority of cases the cause is constitutional; and consists in some error of diet, some lowering influence, as parturition, or some disturbance of health from climatic causes. The surgical importance of the boil is usually trifling, but the remote cause should be carefully investigated, for the constant recurrence of a crop of boils—no infrequent event—is a very serious annoyance, and sometimes even a source of danger. The presence of sugar in the urine is sometimes associated with the appearance of boils and carbuncles, often, as it seems, as a cause, and sometimes, as is said, as an effect of the boil, though this seems doubtful.

The general treatment is therefore of more importance than the local, and this should as a general rule be tonic, due attention being paid to clearing out the bowels. Bark and quinine, with acid, are the tonics usually selected, with wine and good food. Sulphide of calcium in doses of $\frac{1}{6}$ grain frequently repeated is recommended by Dr. Ringer. Surgically little should be done. In the early stage it is said that caustics, as strong liquor ammoniæ, the acid nitrate of mercury, or pure liquor potassæ, may prevent suppuration; but this (as Mr. T. Smith says) appears to be successful usually only in blind boils, which probably would never have suppurated in any case. In general the less the patient is teased with local applications the better. A small poultice with a little laudanum in it is the best application, and when suppuration has formed, a tolerably free incision. A thousand domestic remedies are in use, which probably are all inert except so far as they relax tension by heat and moisture.

Carbuncle is a name given to a spreading inflammation of the cellular tissue, involving also the skin which covers it, having a considerable resemblance to boil, as it tends to rapid sloughing of the cellular membrane; but unlike boil, not limited by any definite boundary, and often spreading to an enormous size. The disease commences with hardness and pain in the part, dusky redness of the skin covering the indurated tissue, and often some constitutional affection, low fever, and much depression. Soon the affected skin gives way in numerous places, and the slough is exposed. If the case runs a favourable course the inflammation stops, the skin between some of the openings sloughs to a greater or less extent, so as to permit the escape of the slough of the cellular tissue, and very commonly the skin perishes in the whole area of the disease. Thus a healthy ulcer is left, which granulates in the ordinary way. When the disease, on the other hand, tends to death, the carbuncle goes on spreading, the fever increases, the patient becomes delirious and comatose, and dies probably with symptoms of blood-poisoning and secondary abscesses. The chief causes of death in carbuncle are pyæmia and asthenia. A very common situation for carbuncle is on the nape of the neck or between the shoulders. The disease is far more common in men than in women.

The objects of treatment are to stop the spread of the inflammation, to allay fever, and to support the patient's strength. Carbuncle is a disease which occurs chiefly in persons broken down either by high living or by some constitutional affection, as gout, diabetes, or kidney-disease. Hence few of the sufferers from it can bear anything like lowering treatment, nor do they bear well any shock or hæmorrhage. There are four main plans of local treatment: 1. To make a crucial incision, taking care to carry the knife into healthy tissues both at the borders and at the base of the carbuncle.

This is an effectual but a very severe measure when the carbuncle is of great extent, as it cannot be carried out without a good deal of bleeding at the time, and secondary hæmorrhage is very common. 2. The thorough application of caustic potash is usually equally efficacious in relieving the pain and checking the spread of the sloughing without any drawback from either shock or hæmorrhage. When the skin has not given way the caustic is freely rubbed on it till a slough has formed, or (better) the skin is divided with a scalpel to insert the caustic. A small piece of the caustic should be put in and allowed to remain, and if the carbuncle is very large, this must be done at several points. 3. Recently the treatment of carbuncle by freely scraping away the diseased tissue has been strongly advocated by Mr. Herbert Page,¹ and others. The patient is placed under the influence of an anæsthetic and a small central incision is made into the parts beneath, and with a Volkmann's or Lister's spoon every particle of sloughing tissue is carefully scraped away, any venous oozing being controlled by pressure. The wound is then irrigated with solution of corrosive sublimate or carbolic acid, dusted over with iodoform, and pressure applied by a wood-wool pad securely bandaged over the part. 4. In many of the less severe cases none of these measures are necessary. The carbuncle may be covered with a warm poultice and left to slough out.² In choosing one of these four plans of treatment, perhaps the best rule is to take into account the amount of pain, the extent of the disease, and the condition of the patient. In a healthy man suffering grievous pain from a rapidly extending carbuncle of no great size, the treatment by incision or erosion is to be adopted; and of the two, the latter is probably the preferable, inasmuch as the operation is apparently attended with less loss of blood than the free crucial incision. But in large carbuncles on unhealthy subjects, I have no doubt that the treatment by caustic potash is the best. The expectant treatment I should myself reserve for cases in which I saw reason to think that the progress of the disease had ceased before the patient presented himself.³ At the same time the expectant treatment is that which is recommended by the high authority of Sir J. Paget and Mr. Le Gros Clark. Sir J. Paget entirely rejects the treatment by incision, and he dissuades all administration of stimulants or of any medicine, except opium when the disease is attended with much pain, and especially dissuades confinement to bed or to the house, believing that fresh air is very conducive to the patient's recovery, and that nothing is really needed beyond keeping the part clean and avoiding the contact of the discharge with the neighbouring integument, which should be protected by a circular piece of some unirritating plaster. The idea that carbuncle is in itself a dangerous affection he utterly repudiates, believing that the few persons who die with carbuncle under the expectant treatment die, not of the carbuncle, but of some of the visceral diseases which often precede it,

¹ 'Brit. Med. Journ.' vol. i. 1888, p. 635.

² Mr. Lowndes recommends in the treatment of carbuncle the injection of a solution of carbolic acid (3iss. to 3viii.); the solution to be injected with a glass syringe as soon as an opening, however small, appears. He says that under this treatment the slough at once ceases to extend, and is soon wasted away in shreds by the injections, and the swelling and hardness rapidly disappear. 'Brit. Med. Journ.' vol. i. 1888, p. 743.

³ A man was lately under my care in whom a carbuncle had been treated on the expectant plan, and the result was an immense ulcer occupying the whole of the nape. Soon after his admission into the hospital another carbuncle formed, and was rapidly extending. A crucial incision soon stopped its course, and he recovered with hardly any mark from this second carbuncle, forming a striking contrast to the tremendous ravages of the first.

and that any danger which might have attended the malady when the treatment by incision was in vogue was really caused by that treatment.¹

It is customary in surgical text-books to notice the plans of treating carbuncle by subcutaneous incision, as recommended by Mr. French, or by pressure, as Dr. O'Ferrall² prescribed. I think, however, that I am correct in saying that they have been found less efficient than the plans above mentioned, and have, therefore, fallen into disuse.

There is, however, one species of carbuncle which is undoubtedly very fatal. I mean those which form on the lips and face, usually in young men, and which have been regarded, though apparently erroneously, as malignant pustule. These rapidly fatal cases are seen almost exclusively in young persons from fifteen to twenty-one, and Sir J. Paget says that out of fifteen cases he has seen, only one recovered. The disease 'commences at one spot, inflammation of the whole lip follows and spreads to the face, and then disease of the lymphatics ensues, with pyæmia as its consequence.'—(Paget.) At the commencement of the disease it is impossible to distinguish it from the ordinary carbuncle which does sometimes attack the face, though the occurrence in a young healthy adult should always excite apprehension. Sir J. Paget, who was at one time inclined to deny the identity of this disease with common carbuncle, has now changed his opinion, and is convinced that the disease 'is true carbuncle, which, because of some peculiarity in the textures of the lip, especially in young persons, is peculiarly apt to infect the blood and generate acute pyæmia.' No local measures are of any avail, except perhaps such incisions as are necessary to relieve tension.³ The patient's only prospect of benefit from treatment seems to be in the copious administration of quinine, so as to produce the symptoms denominated cinchonism; but the statement above quoted from Sir J. Paget's experience shows how feeble the chance is.

Facial
carbuncle.

Chilblain is an affection especially of childhood, though it is not confined to children. Men suffer from it far less than women. The affection consists in inflammation of the skin, often proceeding to ulceration (broken chilblains), and even in some cases to gangrene; but characterised by the peculiarity that the chilblains are liable to periodic attacks of congestion, generally in the afternoon or after dinner, sometimes after going to bed. Chilblains appear to be directly caused more by thawing after cold than by the immediate action of the cold itself. They attack the most exposed parts of the body—the hands, the lobes of the ears, the end of the nose, and particularly the feet, where the circulation is most languid. The persons chiefly affected are those whose hands and feet are liable to become cold and livid from slight causes.

Chilblains.

Much may be done to obviate the tendency to chilblains by attention to the general health, by insisting on vigorous exercise, by warm clothing, and by good diet.

'As long as chilblains remain unbroken, and if the external surface is not too sensitive to pressure, various stimulating embrocations may be beneficially employed: such as Wardrop's liniment, a mixture of two parts of tincture of cantharides with six of soap-liniment; camphorated spirit; equal parts of turpentine and copaiba; or tincture of iodine and soap-liniment. When the

¹ See Paget, 'On the Treatment of Carbuncle,' 'Clin. Lect.' p. 252.

² 'Dublin Hosp. Gazette,' 1858.

³ See a case related by Dr. Burrell, 'Am. Journ. Med. Sci.' July 1890.

external surface is very tender, a good local application is formed by a mixture of two ounces of collodion, six drachms of Venice turpentine, and three drachms of castor-oil ; or tender chilblains that do not itch may be covered over by adhesive plaster spread upon kid or chamois leather.¹ Itching may be relieved by mustard baths, or by rubbing with snow. Vesicated chilblains may be coated with collodion and castor oil. For the ulcers a dressing of poultice and Friar's balsam, or of balsam of Peru, may be recommended.

The nails are liable to many disorders, of which it will be enough to enumerate the following :—

Onychia.

Onychia, or onychia maligna, is a peculiar form of foul ulceration around the nails of children, originating in a crush of the end of the finger, which seems to loosen the connection between the nail and its matrix. The end of the finger becomes unusually enlarged, red, and congested ; and the nail is thinned, blackened, and separated from the soft parts by a very foul ulcer running like a crescent across the finger. This ulceration may go on till the phalanx is exposed and mortifies, or till the joint becomes involved. The remedy consists in removing the nail, if loose, with a pair of forceps, dressing the ulcer with an arsenical lotion (liq. potass. arsenit. ʒij. aquæ ʒj.), or with black wash, and attending to the state of the general health.

Syphilitic disease of the nails.

The toe-nails, and sometimes those of the fingers, are affected in constitutional syphilis. There is ulceration beneath the nail as in onychia maligna ; but unaccompanied by the peculiar fœtor of that disease, and not attended with so much swelling of the soft parts. There are the cracks between the toes (rhagades) which are so often found in syphilis, and most probably other marks or remains of constitutional syphilis. It is a late symptom, generally in the tertiary stage, and yields rapidly to local mercurial treatment (fumigation or black or yellow wash) and large doses of iodide of potassium.

Psoriasis of the nails.

Psoriasis of the nails occurs either as a syphilitic or spontaneous affection ; in the latter case it seems that a parasite like that of ringworm is sometimes present,² and it seems sometimes to be caused by the contagion of ringworm. The nail becomes partly separated from the soft parts, and its layers heaped up on each other, like the scales of an oyster shell, much in the same way as the scales of epidermis are heaped up in psoriasis of the skin. It is a troublesome affection, which must be treated, if syphilitic, by a prolonged but mild mercurial course ; if non-syphilitic by arsenic. Locally Mr. T. Smith recommends rubbing off the superfluous scales gently with glass or fine sand-paper, or the application of dilute acetic acid, and dressing the margin of the nail at night-time with a mixture of white precipitate and tar ointment.

Ingrowing toe-nail.

Ingrowing toe-nail is a very troublesome affection, and by preventing active exertion, causes inconvenience far out of proportion to its apparent gravity. It occurs from pressure of the toes together, whereby the outer edge of the nail of the great toe becomes imbedded in the skin, and this pressure gradually produces ulceration, leading to the formation of a crop of irritable and painful granulations at the margin of the ulcerated part. The imbedded portion of the nail is often cut away by the patient or by some one whom he consults ; but this is only a palliative, and often not even that, for

¹ 'Syst. of Surg.' 3rd ed. vol. ii. p. 962.

² Hilton Fagge, in 'Path. Trans.' vol. xxi. p. 407.

the pressure still continues to act, and the newly cut edge of the nail is sometimes even more irritating than before.

The principles of treatment are twofold. The most important is to relieve the toes from all pressure by the use of proper boots, or even of an apparatus to disengage the toes and prevent them from compressing each other.

Then the ingrown nail must be disengaged from the flesh. This is effected by raising the buried edge. A little lint is to be tucked in between the nail and the flesh, the centre of the nail being if necessary scraped or notched in order to allow its side to be raised more easily. The irritable granulations are to be repressed by dusting them with the oxide of zinc, or by the use of the nitrate of silver in stick. In many cases the plan of shaving off all the exuberant granulations and other parts down to below the level of the ingrowing nail is successful—care being taken not to allow the granulations from the incision to become again exuberant.

Finally, there are many cases where the removal of the nail, though, I believe, it is never actually necessary, is very expedient. For though, no doubt, by dexterity and patience the complaint can always be cured, yet the patient will be deprived of the power of active exercise for a long time, so that in severe or long-standing cases it appears on the whole better to remove the nail under anæsthesia. The sharp point of a strong pair of scissors being driven beneath the middle of the nail down to its root, each half is torn out with a stout pair of forceps. In a day or two the patient can walk about, the sore being protected with a little cotton-wool to prevent the friction of the shoe, and the granulations will have disappeared before the nail grows again.

Avulsion
of the nail.

CHAPTER XLIII.

MINOR AND OPERATIVE SURGERY.

MINOR SURGERY.

THE subject of minor surgery will comprise bandaging, the making of splints, sutures and their application, counter-irritation and cauteries, blood-letting and vaccination.

Bandag-
ing.

The essence of success in bandaging is to apply the bandage so as to cover the whole surface with it, and to make equable pressure over the whole sufficient for the purpose in hand, but never so severe as to produce œdema of the part below, still less to cause sloughing of the skin. A bandage is made usually of linen or calico, but for some purposes flannel is more convenient, and occasionally elastic webbing may be used, though this requires more care in its application, since, if it is stretched too much whilst it is applied, its recoil may easily produce more pressure than is safe. The bandage is generally rolled up into a single roller (Fig. 402), sometimes into a double-headed roller (Fig. 406), the bandage being rolled up from both ends to the middle.

Spiral
bandages.

Bandages are spoken of as simple or continuous and compound. The continuous bandages are best exemplified by those of the leg and arm (Figs. 402, 403). These bandages, which are carried continuously up the limb, are thence called 'spiral.' In consequence of the increase in thickness of the limb upwards the bandage if simply rolled round would be quite loose and soon fall off. It is necessary, as shown in the figures, to *reverse* the bandage, by laying a finger on its centre while the bandage is turned round on itself, till a part of the limb is reached which is cylindrical, when the reverses are no longer needed. Each turn of the bandage should lie half over the one below it, and when the hole is completed the bandage should lie quite evenly without any pucker, with the reverses forming a continuous line up the limb. In bandaging the leg (Fig. 402) a turn of the bandage is first taken from the ankle to the foot and back again, like a figure of 8, to afford a hold for the bandage, and then the bandage is carried as far over the foot as necessary. If it is required to include the heel this may be done by a turn carried from the ball of the great toe over the heel, and secured by circular turns round the foot. In bandaging the arm (Fig. 403) an excellent hold is afforded by the thumb. The bandage commences over the wrist, turns round the palm of the hand, through the cleft between the thumb and index finger, makes as many turns round the hand as is necessary to secure any dressing which may be applied there, and then passes spirally up the limb, being reversed as may be necessary.

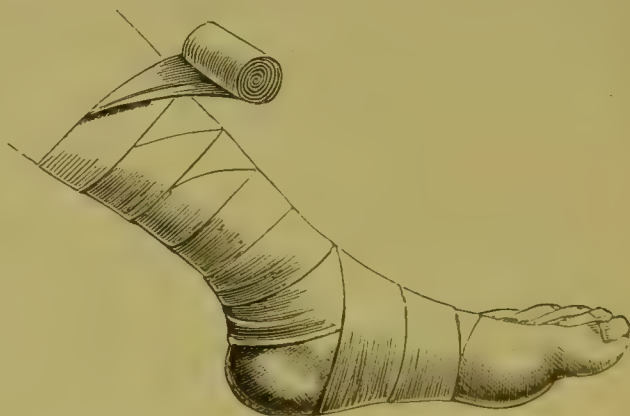


FIG. 402. The common leg bandage.

In bandaging the chest, it is often necessary, as mentioned at page 210, to reverse the bandage, and a brace or support should always be applied.

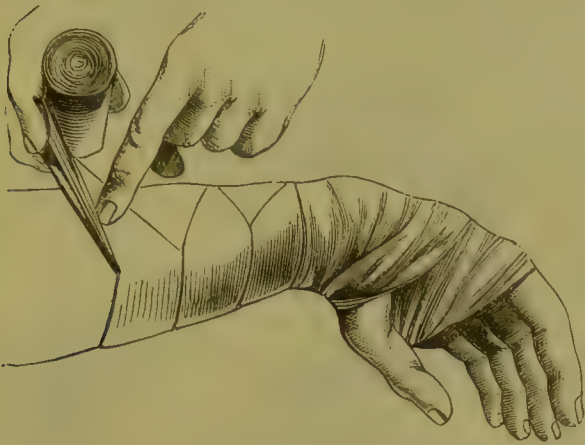


FIG. 403. Bandage for the arm and forearm.

When the flexures of the joints, knee, groin, elbow, or shoulder are reached, it is no longer possible, even by means of reverses, to apply the bandage continuously so as to make equable pressure. Either the figure-of-8 bandage must be employed, or a special bandage contrived.

The figure-of-8 bandage is best exemplified by the spica bandage which is used to secure the dressings after an

Figure-of-8 or spica bandage.

operation for hernia, or a poultice to a bubo. One or two turns are first taken round the thigh to afford a hold. Thence the bandage is carried to the iliac crest on the same side, and across the back to the opposite ilium, returns



FIG. 404. Spica bandage.

across the groin, and is carried round in this figure-of-8 fashion as often as necessary, being finished off and fixed by a circular turn or two round the abdomen. It is a useful precaution to tack the bandage together at the crossings. The knee or shoulder may also be included in numerous turns of a figure-of-8 bandage gradually converging as they cross, or a very convenient bandage may be made as in the figure (Fig. 405) by tearing an oblong piece

Four-tailed bandage.

of calico or linen down the middle at either end till a square undivided piece is left in the middle. To avoid further tearing, a stitch is put at the end of each

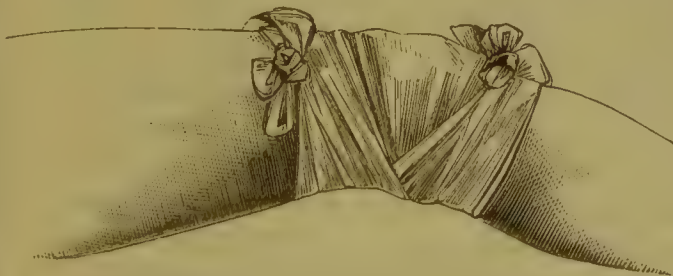


FIG. 405. Four-tailed bandage for the knee.

The figure-of-8 bandage is also very commonly used in fracture of the clavicle, the crossing being made between the scapulæ.

The double-headed roller bandage is used when it is necessary to secure the turns of one

Double-headed roller.

Capelline bandage.

of the heads of the roller by crossing the other over it, as in the 'capelline' or scalp bandage represented in Fig. 406. The centre of the bandage between the two rollers is laid on the occiput, and, when the rollers meet on the forehead, they are crossed one under the other, and the first is turned vertically over the scalp, while the second pursues its horizontal direction. Starting

again over the occiput, the two bandages are changed into opposite hands and the first is brought back again across the vertex to the forehead, half covering its former turn, and so on. When it has become nearly horizontal, the second roller is taken vertically across, and is managed in the same way, and thus the whole head is covered with an evenly-pressing cap of bandage. This is a very efficient bandage when pressure is required over a number of different parts of the scalp. When only a single point requires compression, as in bleeding from one artery, the central part of the bandage is laid on the compress which secures that vessel; then the ends are passed horizontally around the head, or vertically round the head and chin, as may be most convenient; then crossed over each other and turned at right angles to their former direction, and so on until sufficient pressure is made, when they may be firmly tied together over the compress and secured to it by stitches. Stitches may also be placed at the crossings of the bandages to make all secure.

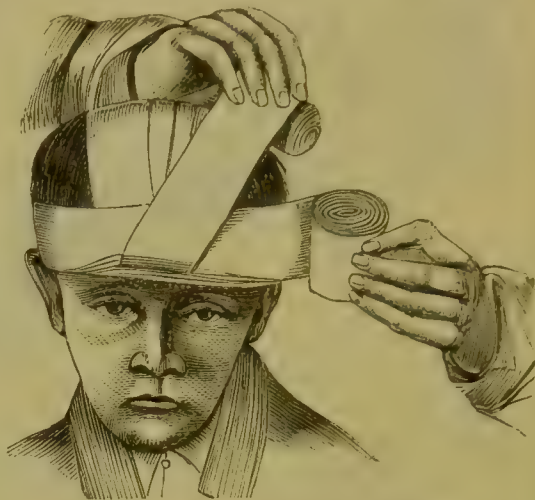


FIG. 406. Scalp or Capeline bandage.

T-bandage.

The **T**-bandage is used for the perinæum, in order to secure catheters, to support a pad put on the anus in prolapse of the bowel, poultices in the perinæum, and other dressings in this region. The figure represents one made expressly. A belt passes around the abdomen, above the iliac spines. To this is attached, in the middle line behind, a vertical piece which is divided into two at the sacrum, and the two ends are brought up on either side in front and secured through a loop on the horizontal belt. In practice this apparatus is usually made impromptu, out of two pieces of bandage or thick tape. Care must be taken to place a stitch where the vertical tape is split behind to prevent its tearing, since that would loosen the whole bandage. In tying in a catheter, it is usual to secure the end of the instrument by tying a double ligature on it with a clove-hitch, so that there are two ends in front and two behind. The anterior ends are tied to the horizontal piece or to the ascending pieces not far from it, and the posterior ends to the ascending pieces near the ischial tuberosities, both being left just slack enough to allow the catheter a little motion as the patient changes his position, but not so much as to allow the end to pass out of the bladder. In applying the **T**-bandage to a female the vertical piece may be made single if it is required to make pressure on the vulva, being unpinned when the patient wants to pass water.

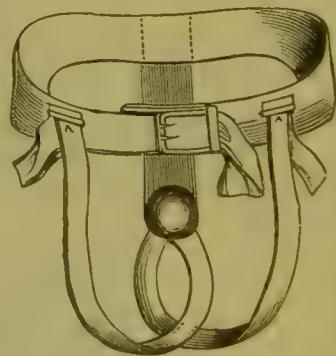


FIG. 407. T-bandage.

Securing a catheter.

Suspensory bandage.

The suspensory bandage supports the testicles. It is best procured ready-made from the instrument-maker. When one is not at hand a bandage is passed horizontally round the abdomen; the apex of a handkerchief, folded into a triangle, is fastened to it in the middle line in front, so that the middle

of the base reaches the centre of the perinæum. The extremities of the base are then brought up on either side of the scrotum and turned round the belt on either side of the middle line, from behind forwards. They are now secured with pins to the belt, or they may be tied together in a bow or knot over the root of the penis. In this way the scrotum can be raised to the level of the front of the thighs.

The many-tailed bandage, or 24-tailed bandage, as it used to be called, is now chiefly employed after abdominal section. It is made on a foundation of a single strip of bandage or cloth, which is laid along the patient's back. To this foundation a number of strips of bandage have been sewn at right angles from above downwards, each overlapping the former by about half its width, the strips being rather more than half as long as the circumference of the body. The lowest (most superficial) is first drawn tight, then covered by the next one, and so on. The body is thus bandaged evenly as if by the spiral roller. The whole apparatus can be withdrawn by loosening the transverse strips from above downwards, and drawing the whole away, behind the body. A fresh one can then be slipped under the trunk, and the bandage renewed, without disturbing the patient at all. The foundation piece is sometimes omitted, but then the bandage is not so secure, nor can such firm pressure be made with it.

The many-tailed bandage.

Closely connected with the subject of bandages is that of splints, or immovable apparatus. The permanent wooden splints used in fractures are generally bought ready-made from the instrument-makers, though the surgeon should always be prepared to fashion them for himself on an emergency. A useful form for country practice is what is called 'Gooch's splint,' composed of thin strips of light wood, bound together with a webbing. This is solid enough to give support in most fractures, easily moulds itself to the convexities of the limb, and can be readily cut by the surgeon with a stout sharp knife to such lengths and shapes as the case before him requires.

Splints.

The ordinary forms of immovable apparatus are made of bandages, or cloths applied to the limb and either stiffened with some composition, or lined with leather, pasteboard, gutta-percha, or some such malleable material. The simplest of all these is the starch bandage, which is usually applied over the pasteboard splint, or may be used by itself, a layer of wadding or soft cloth being between it and the limb. It consists merely of a common roller which is soaked in thick starch after it has been applied, the limb being kept perfectly at rest till the starch is dry. Gum-and-chalk is stouter than this, but cracks more readily. It is made of mucilage, thickened by chalk, rubbed up with it to the consistence of thick cream. In applying these substances they should be freely smeared into the bandage by the hand or a coarse brush in the direction of the turns of the roller, and they may be made thicker by applying another bandage over the first. Many other substances have been introduced for making splints, such as paraffin, silicate of potash, and glue. The paraffin seems to be in every way inferior to starch or gum; the silicate of potash is light and firm but not very strong. As a covering for a plaster-of-Paris bandage it is often very useful. Glue makes a very good splint if the best French glue can be got; but lately this has seemed difficult. About one-fourth of its bulk of methylated spirit is added to the melted glue, and when the splint is hardened it is cut down the middle, and a series of eye-lets let into holes which are punctured in it, and it is then laced. The splint is not so solid as that of plaster of Paris or pasteboard, but it pos-

Starch bandage.

Gum-and-chalk bandages.

Other immovable apparatus.

sesses the recommendation that it can be taken off and put on as easily as a laced boot.

Pasteboard
splint.

The pasteboard splint is an excellent one; in fact, after trying all the modern substitutes for it, I see little advantage in any of them, for ordinary cases of fracture, over this old one. Pieces of pasteboard are cut to a pattern which shall embrace the limb, the pattern being generally cut out of an old newspaper. They are then soaked in warm water for a sufficient time. When quite flexible they are rapidly moulded to the limb, their edges are trimmed off with the fingers, and they are bandaged on. After the pasteboard is quite dry the outer bandage is starched.

Leather
and gutta-
percha
splint.

A leather splint is still more secure than one of pasteboard, since it cannot crack; but it is more costly, and a little more troublesome to make. A pattern is taken as before, the leather soaked in warm water till quite soft, moulded, trimmed with stout scissors, and finished as the pasteboard splint. Gutta-percha is more easily moulded, is much cheaper, and requires only dipping in nearly boiling water for a very short time to soften, but it has the great disadvantage of being impermeable to the perspiration.

Plaster-of-
Paris
splint.

The great advantage over all these of the plaster-of-Paris splint for certain emergencies is the rapidity with which it hardens; against which must be set the disadvantage that it is more difficult of removal, and cannot be re-applied or modified as the others can, if swelling occurs, or if from any cause it becomes desirable to examine the limb. The ordinary splint, therefore, appears better for most cases. On the other hand, it is easy to cut a hole in the plaster splint to expose the wound of a compound fracture or operation, and for such cases it is now in extensive use. It is thus made. One or two rollers of open material are charged with dry plaster of Paris by rubbing in as much as the bandage will hold. The surgeon has a bag of plaster and a basin of water ready. The usual layer of wadding or cotton-wool being applied, the bandage is placed in the water for a very short time, and is then applied, water being washed over each turn as it goes on, and fresh plaster being rubbed over it, as much as required. Two layers of bandage well plastered will make a good splint, the exterior of which can be smoothed and varnished with paraffin or covered with a layer of silicate. In order to expose a wound its position should be marked with a thick wad of cotton-wool, and then the plaster can be dissolved with acid in that part and picked away till the wad is entirely exposed. If the plaster is good the bandage will have set in a quarter of an hour, and the patient can then be removed—a great desideratum in military practice. Mr. Bryant speaks highly of the Bavarian splint, which is certainly easily applied, but is rough and fits far less well than the plaster splint made with the bandage as aforesaid. Two pieces of oblong flannel are sewn together down the middle. The upper (or inner) one is swathed round the limb, well charged with plaster-of-Paris paste, and crossed by the outer one, which is pressed into the plaster and secured with one or two straps, or bandages. The splint is easily removed by tearing the edges of the flannel asunder, the stitching of the two pieces behind acting as a hinge. A still more convenient plaster-of-Paris splint, possessing all the advantages of the Bavarian splint, and being at the same time much simpler, is the one introduced by Mr. Croft.¹ Each splint is made of two layers of house-flannel cut into such a shape as to encircle one half of the limb to be splinted. The one layer is applied to the limb, while the other is thoroughly soaked with plaster of Paris of about the consistence of cream and put on

¹ 'Med.-Chir. Trans.' vol. lxiv. p. 295.

over it. Both layers are then moulded to the part and firmly bandaged in position with a muslin bandage. In order to remove the splint, all that is necessary is to cut through the bandage on the anterior aspect of the limb and turn the splints outwards.

The most convenient of all these apparatus is that made of Hides's patent felt. The splint is made of felt lined with soft leather, and is hardened by a preparation sold with the felt and put on with a brush, but it is too costly for general use. The poro-plastic felt now in extensive use is made in the same way.

Sutures are made of silk, silver, catgut, hair, and occasionally of other substances. Silver or wire sutures have the great advantage of causing the least possible irritation, since they do not imbibe moisture or putrefy; but they are not supple enough for the more complicated forms of suture. It is sometimes said that silver sutures do not cut. But that is true only when they have no tension upon them. If tied too tight at first, or if the parts

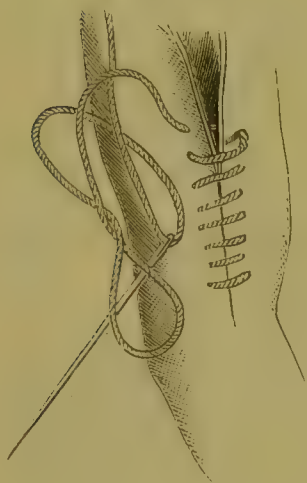


FIG. 408. The continuous suture.

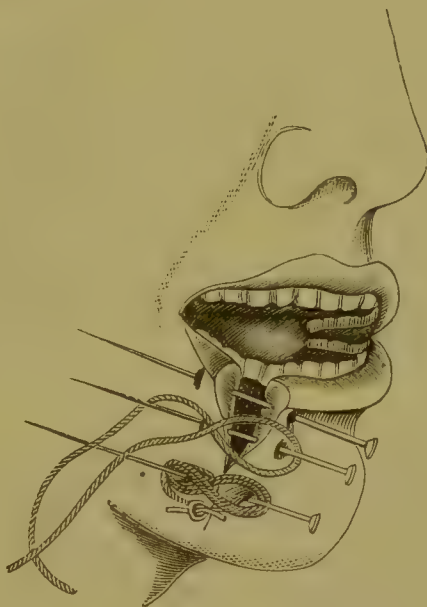


FIG. 409. The twisted suture.

swell afterwards, all sutures will, and must, cut the tissues, and silver, I think, cut faster than others, as being more rigid. Catgut sutures are very little irritating, and they require no removal, since they are absorbed, leaving the knot to drop off in the course of about a week. For the same reason they are inappropriate for sutures which must be long retained. Horsehair is very pliant, makes very little mark, does not absorb moisture, and may be retained any length of time, but it is difficult to tie, brittle, and too delicate to bear any strain. On the whole, silk which has been rendered aseptic remains the most universally useful suture.

The forms of suture are as follows:—

1. The *interrupted*, in which each stitch is knotted as it is made. If silver is used, the stitches are fixed by crossing each end perpendicularly across the other, and twisting them two or three times. The knot should lie on one side of the line of wound.

2. The *continuous* or glover's suture (Fig. 408) is the suture generally used in the post-mortem room. In the living body it is not very often employed, for though it produces a more intimate adjustment of the edges of the wound,

it possesses the distinct disadvantage that a single loop cannot be interfered with without loosening the connections of the whole length of the wound.

3. The *twisted* suture (Fig. 409) is made with a pin, around which the suture is wound in the form of a figure of 8. It is chiefly used in harelip and in wounds made in removing cancer of the lip. When several pins are used, the suture can be finished off separately on each pin (as shown in the figure), or, as is more common, one long piece of silk is used, which is carried on from one pin to the next. The former plan has the recommendation that each pin can be separately withdrawn, but it takes longer to make the suture.

4. The *quilled* suture is used almost exclusively in the operation for rupture of the perinaeum, and will be found described on p. 869 with that operation. It may also be required in some very deep wounds, in order to prevent the bagging of matter into their cavity, by keeping the deep parts together.

Clove-hitch.

For tying a string or towel securely on to anything which it is intended to fix so firmly that it shall resist traction (as the jack-towel or strap with which extension is made in dislocation, or the string by which a catheter is tied in the bladder) the clove-hitch is useful. Here the string is made into two loops, and the ends of the second loop are passed through the first in the manner represented in the figure. If the hitch is properly made traction on the ends only fixes the loops more firmly.



FIG. 410. Clove-hitch.

Counter-irritants and cauteries.

Blisters are the commonest form of counter-irritation, and are most commonly made of the Spanish fly, either in the form of the common blister, the blistering-fluid, or the blistering-paper. For mere stimulation (rube-facients) mustard is almost universally employed. The method of employing these substances belongs more to treatises on Medicine. When instantaneous vesication is required it can be obtained by applying lint steeped in chloroform to the skin, covered with a watch-glass, or by liquor ammoniæ, or by the transient application of a hot iron; but the latter is not a very safe form of vesicant, for if left on too long it might produce sloughing.¹ There are few cases in which there is any real necessity for more rapid blistering than cantharides will produce, and in these chloroform can be employed. When the blister has fully risen, the serum is to be let out by pricking it and a little cooling ointment applied, unless it is desired to keep up the discharge, when the cuticle must be cut all round, left to cover the raw surface, and covered with ung. sabinæ, or ceratum cantharidis, or blue ointment.

More potent counter-irritation is produced by the croton oil liniment or the tartar emetic ointment, which brings out a crop of pustules over the whole part to which it is applied.

Issues.

Issues are now much more rarely employed than was the case formerly, but their beneficial influence in some of the severer cases of joint-disease seems to me indubitable. They are now, I believe, always made with caustic

¹ A 'thermal hammer' was in use some time ago bearing the name of Dr. Corrigan. It was prescribed to be immersed in water at 120° F., and held in contact with the skin for two or three seconds as a rubefacient, and for 5-10 seconds as a vesicant.

potash, either pure or in the form of the Vienna paste, a mixture of 5 parts of caustic potash with 6 parts of quicklime. A piece of plaister with a hole corresponding to the size of the proposed issue is applied, the hole filled with the caustic, and covered with cotton-wool or lint and strapping. When the skin is thoroughly destroyed a poultice hastens its separation, and the ulcer is kept from healing by occasionally touching its edges with caustic potash. This is less painful and inconvenient than the old plan of bandaging peas on the sore. The slough resulting will be about twice the size of the hole in the plaister.

Mr. T. Smith speaks of establishing issues by means of the moxa, but I have never seen this done, and, indeed, I have scarcely seen the moxa used for many years. It is a very painful application, which used to be employed either as a counter-irritant or a cautery. A piece of lighted German tinder was placed on a frame, and the flame directed to the skin by means of a blow-pipe. The utility of the method is hardly so indubitable as to justify such a barbarous proceeding. I remember, however, once seeing it work as instantaneous a cure in a case of hysterical paraplegia as 'Duke Humphry's miracle' in Shakespeare's play. Moxa.

Setons also, as counter-irritants, are becoming rapidly things of the past. They are made by pinching up a large fold of skin and passing a skein of silk threads underneath it through the cellular tissue above the deep fascia. For this purpose a needle of peculiar construction, with a very large eye, is convenient. If this is not at hand a straight knife must be passed in the track of the seton, and the silk conveyed along it by means of an eyed probe before the knife is withdrawn. The skein of silk is loosely knotted, and should be moved a little each day backwards and forwards as soon as supuration has commenced. When used to empty abscesses or cysts one or two threads run through with a common needle will suffice. Setons.

Cauteries are divided into actual and potential. The actual cautery is sometimes used as a counter-irritant, in which respect it is of the most signal service in painful affections of the joints, a white-hot iron, shaped like a hatchet, being drawn rapidly in cross-lines over the skin of the part so as just to scorch the epidermis and possibly produce very superficial sloughs. When used as a hæmostatic the cautery should be broader, and should be kept longer in contact with the tissues, but not so long as to stick to them and pull them off. Some surgeons prefer to use the iron at a dull red heat for this purpose. In destroying morbid growths—for which purpose, however, it is generally inferior to the potential cauteries—it should be applied very lightly at first, and then others should be applied more deeply till the parts are as thoroughly charred as possible. Actual cauteries.

The galvanic cautery has the great advantage that its heat is renewed as fast as it is lost, but of course it can only be applied over a very small surface. Its chief use is in cutting through vascular parts, such as the tongue or the base of a pile, and it is used also for destroying the walls of sinuses and producing a healing surface. Many ingenious apparatus have been constructed for applying this form of cautery in various operations, based on the cautery of Middeldorpff; but it would be out of place to describe them here. Galvanic cautery.

A most manageable and ingenious cautery has been recently introduced, called the Benzoline or Paquelin's cautery. It consists of a Richardson's spray-producer communicating with a hollow stalk which terminates in a double plate of platinum, so that the vapour of the benzoline passes between Benzoline cautery.

the laminæ of platinum, which are bent into the shape required for the cautery. The platinum is placed in a spirit-lamp, and then as the vapour passes between the heated surfaces it ignites, and by increasing the stream of vapour the metal can be raised to a white heat in a very short time, or by diminishing the stream the heat can be reduced as required. The burnt vapour escapes from holes in the lower part of the stem.

Potential
cauteries.

The potential cauteries are substances which enter into rapid chemical combination with the tissues of the skin or other parts, chiefly by withdrawing its fluid element from it, and so disintegrating the part to which they are applied. The chief substances in use are as follows: Sulphate of copper, which is used chiefly in the form of blue lint—i.e. lint steeped in a saturated solution of the salt. This is a useful hæmostatic, and produces a superficial slough of the exposed parts to which it is applied. Sulphate of zinc in the form of powder, or made into a paste with glycerine, is a useful caustic in warts, condylomata, and growths about the female urethra, according to Sir J. Simpson. I have seen these growths treated more frequently with the fluid caustics, of which acid nitrate of mercury and nitric acid are the most manageable and the handiest. Sulphuric acid also, made into a sort of paste with sawdust or asbestos, is a very efficacious and a very painless caustic. Arsenical paste is recommended by many writers on skin-diseases as more efficacious for stopping the spread of destructive ulceration than any other, but there is no question that its use is by no means free from danger, and that fatal results have occasionally followed.¹

'Cauterisation en
flèches.'

The most universally serviceable of the potential cauteries are the chloride of zinc and the potassa fusa. The former is disguised in various ways by quacks and sold as a nostrum. It may be used pure—rubbed on to the parts in stick, or mixed with flour or plaster of Paris into a paste, or made into sticks or pencils with flour, which are stuck like arrowheads into the substance of the growth to be destroyed. This is the plan of 'Cauterisation en flèches' of M. Maisonneuve, and it is an admirable method of removing morbid masses below the skin—e.g. enlarged glands. The patient being narcotised if it is thought necessary, a knife is passed deeply into the growth and the arrow of caustic inserted. This is done in several places, the caustic arrows cut close to the skin and left in. A dose, or a subcutaneous injection, of morphia will dull to a certain extent the severe pain which follows for some hours. Then the skin turns a dead white. A poultice is applied, and in a few days a mass shells out something like a billiard-ball, exposing a surface which if healthy will cicatrise, and if not it may be treated with renewed applications of the caustic. Another way of applying the chloride is by producing a superficial slough and then scoring it, and stuffing the incision with the caustic. Potassa fusa is applied pure, or as Vienna paste, and is also a most excellent caustic.

The pain of the cautery is somewhat dulled by the application immediately afterwards of some substance which will decompose it, as chalk for the mineral acids, and vinegar for caustic potash; and their action is limited to the part which is to be destroyed, by smearing those in the neighbourhood with oil or covering them with a ring plaister.

¹ 'In the practice of M. Roux the application during a single night of a paste containing 4 per cent. of arsenic to a surface of little more than an inch in diameter proved fatal.—'Syst. of Surg.' 3rd ed. vol. ii. p. 651.

Blood-letting is either general—venæsection and arteriotomy—or local—leeching and cupping.

Blood-letting.

Arteriotomy is now, I think, given up; at least I never saw it practised but once. If any one should choose to open the anterior branch of the temporal artery no special directions would be necessary. The vessel lies close under the skin, and all that is required is to touch it with the point of a lancet. When the required quantity of blood is obtained, the artery must be cut across, and the puncture closed with compress and bandage.

Arteriotomy.

But the only method of general blood-letting now in use is venæsection at the bend of the elbow. A bandage is tied round the arm tight enough to make the veins of the forearm start out. Then the more prominent of the two veins at the bend of the elbow is selected. This is usually the median basilic, which has the further great recommendation that it is firmly supported by the bicipital fascia, and will not retract from the lancet. The surgeon should assure himself previously that there is no abnormal artery coursing below the skin, and that he is away from the position of the brachial. He then steadies the vein with his left thumb while he dips the lancet into it, and lets the lancet cut itself out by describing a circle with it, thus making a free incision which lies rather obliquely to the axis of the vein. The patient can increase the flow of blood by grasping a stick or a

Venæsection.



FIG. 411. Venæsection.—After C. Heath.

piece of bandage and working his fingers upon it. When as much blood as is desired has been obtained, the wound in the vein is closed with the thumb, the arm-bandage unloosed, a compress of lint applied, and bound on the wound by the arm-bandage arranged in a figure of 8. A wound of the brachial artery has often been caused by want of skill in this little operation, and very often has been successfully treated by firm compression. If the arterial wound does not heal and a varicose aneurism forms, it must be treated on the principles explained on p. 566.

Leeching has already been referred to (see p. 17), and cupping is now seldom prescribed; still it is a very useful measure in many cases, and I cannot think that its present neglect will be permanent. At any rate, a surgeon ought to know how to cup if required. The operation is done with a scarificator, which is a box containing a spring to which are attached a number of lancet-blades in two parallel rows, so set that when the spring is drawn up and the bottom of the box laid on the skin, by touching the spring the blades are released, and as they pass through the slits made for them in the bottom of the box they project out of the slits and so cut the skin, making a number of scarifications or small incisions through it just into the cellular tissue.¹ Then the surgeon takes one of the cups and puts the 'torch'—a wick steeped in spirit—into the cup so as to exhaust it, and claps it rapidly over the scarifications. The cups are graduated in order to mark

Cupping.

¹ The incisions ought not to be too deep, otherwise the subcutaneous fat may be squeezed out and so plug the cuts as to prevent bleeding.

the quantity of blood drawn, and the given quantity is obtained by renewing the cups, which, however, should never be put on in exactly the same line. The depth of the incisions can be regulated in setting the spring according to the thickness of the skin about to be operated on. Dexterity in cupping can only be acquired by constant practice and attention to a number of small details which it seems hardly worth while to describe here, but which are soon learnt by experience.

Vaccina-
tion.

Vaccination consists in the insertion below the cuticle of the matter from the cowpox, so as to produce that disease in the person vaccinated, the vaccine lymph being absorbed by the vessels of the cutis vera. The first object of the vaccinator is to bring the lymph into proper contact with the vessels of the skin without drawing any blood, or as little as possible. To this end the skin is stretched tight, the cuticle is gently raised by inserting the lancet-point obliquely through it, and the lymph is then introduced. Numerous contrivances have been devised for vaccination. The lancet may have a groove in it which is filled with lymph before its introduction, or after the puncture is made may be charged by dipping it into the lymph, then again inserted into the puncture, and the lymph squeezed off by pressing the edges of the puncture together, or an ivory or quill point may be used instead of the lancet for this latter purpose. Instead of the lancet puncture, scratches may be made through the cuticle, into which the lymph is rubbed, or the cuticle may be raised by a minute blister, and when this is pricked it may be filled with lymph, as Mr. Ellis recommends; or the cuticle may be entirely scratched off the part to which the vaccine is to be applied. The lymph also is procured from the vaccinifer in many different ways. The one now most in use is to charge capillary glass tubes with it, seal them up, and preserve them for use, when the ends are broken off and the lymph blown out of them on to the lancet. It is more satisfactory, however, to take the lymph fresh from the arm of an infant who has been successfully vaccinated and use it the moment it is drawn, and perhaps more satisfactory still to obtain it fresh from the calf. Another method, but a less secure one, is to charge ivory points with it and allow them to dry, moistening them in steam before using them; or to preserve it dry between two plates of glass.

The result of primary successful vaccination is stated in the instructions to public vaccinators to be as follows:—

‘The puncture may be felt slightly elevated on the second day; on the third it is surrounded by a slight halo of redness; by the fifth a distinct vesicle will be formed, having a slightly elevated margin and a depressed centre; on the eighth day the vesicle should have reached its perfect condition, when it is pearl-coloured and distended with clear lymph, its margin being tinged, firm, and shining.¹ From this period the redness around increases in extent and intensity until the tenth day, when there is often well-marked swelling and induration of the subjacent cellular tissue. On the eleventh day the areola begins to subside, leaving as it fades two or three concentric rings of redness, the vesicle begins to dry up, assuming a brownish colour, the remaining lymph becomes opaque, and generally concretes, forming by the fourteenth or fifteenth day a dry reddish-brown scab; this contracts, dries, blackens, and, finally, falls off about the twenty-first day. The resulting cicatrix is permanent, slightly depressed, dotted, or minutely pitted.’

Secondary vaccination, or the vaccination of persons who have been vacci-

¹ It is at this period that the lymph should be taken from the vesicle for use in vaccination.

nated before, sometimes gives results identical with these, or differing only very slightly from them; showing that the subjects were in no respect protected by the previous vaccination, although probably if they had contracted small-pox the disease would have been milder. But it is more common for the results to be variously modified, and sometimes severe inflammation of the glands and absorbents is produced.

Secondary
vaccina-
tion.

It is always usual to vaccinate in three different spots about an inch distant from each other, and some believe that the protection is more complete when this is done in both arms—i.e. when the patient is vaccinated in six places at once.

OPERATIVE SURGERY. ANÆSTHETICS.

THE subject of Operative Surgery, considered in itself, apart from the questions of the diagnosis of the disease or lesion, the indications for the operation, and the previous and subsequent management of the patient, comprises the three following topics:—(1) the administration of anæsthetics, (2) the arrangements for the prevention of hæmorrhage, and (3) the operative manipulations.

The administration of anæsthetics has now been developed almost into a special branch of practice in large cities; and the custom is a convenient one, as it permits the surgeon to attend to the details of the operation exclusively, though it cannot be said to be necessary, since every surgeon who is capable of operating ought to be competent to superintend, and if necessary to administer, the anæsthetic.

Anæsthetics are divided into *local*, or those which merely benumb the part to which they are applied, and *general*, or those which abolish the sensation of the whole system. The latter are of universal, the former only of very limited, utility. We will speak first of local anæsthesia.

The local anæsthetics at present in use are a freezing mixture of ice and salt and the pulverised vapour of ether, and in both of them the rapid action of extreme cold is the agency employed for abolishing the cutaneous sensation. This it does so rapidly that there is no necessity for continuing the action of the cold for any length of time. The skin turns of a dead-white colour and becomes somewhat puffy, and may then be cut, cauterised, or otherwise treated without any sensation on the part of the patient. This insensibility lasts for a few minutes, after which the circulation and sensation return. No pain accompanies either the freezing or the thawing.

Local
anæsthesia.

The mixture of ice and salt is more convenient when the anæsthesia has to be distributed over a considerable surface, the ether-spray when it is to be limited to a small portion of skin or to the line of a single incision. In the former—introduced into practice by Dr. J. Arnott¹—a quantity of rough ice is pounded into pieces, none of which should be larger than a nut, and rapidly mixed with as much salt. The pounded mixture is then put into a bag of rough muslin (so that the brine may run off as it is formed), and is laid closely round the skin which is to be frozen. After about four minutes the characteristic appearance of the skin will show that the desired effect has been produced. The application of the vapour of ether as an anæsthetic was first suggested by Dr. Guérard,² and has been applied by Dr. Richardson by means of the spray-producer, which is modelled on the instrument originally

¹ 'Lancet,' Oct. 30, 1858.

² Trousseau et Pidoux, 'Thérapeutique,' 8th ed. vol. ii. p. 349.

invented for pulverising the vapour of essences. The ether should be pure, or washed, and the direction of its vapour to the spot or the line chosen for the incision during a very brief period will produce such intense cold as to render the skin quite insensible.

The great objection to local anæsthesia is the very limited extent to which it reaches. It can only be applied to the very surface of the body, and only extends to the part which is actually frozen, the parts around being rather more sensitive than natural. It has been apprehended that the frozen parts would be liable to slough, but I never saw any foundation for this apprehension.

Another mode of producing local anæsthesia, viz. by the application of a solution of cocaine, has recently been used, especially in ophthalmic surgery. The preparation used is a watery solution of the neutral hydrochlorate of cocaine of a strength varying from 5 to 20 per cent. Its anæsthetic properties were first discovered by Köller of Vienna, and it soon came to be largely used in ophthalmic operations, for which it appears to be admirably adapted. Subsequently its use was extended to other mucous tracts, and it is now largely employed for minor operative purposes not only on these surfaces, but all over the body. It may either be painted upon a mucous surface, or injected into the submucous or subcutaneous tissue, or applied by means of a spray. It usually produces anæsthesia in from five to ten minutes after it has been applied.

Ether and
chloroform.

The general anæsthetics which are in most common use are ether and chloroform. After the first discovery of anæsthesia by the inhalation of ether, by one of the American dentists Morton or Wells, the details of the novel method were, of course, somewhat uncertain, and the administration was attended with some difficulty, which resulted chiefly from the surgeon not trusting to the ether sufficiently, and administering it too gradually. I do not know that I can do better than quote a letter from Mr. Warrington Haward in the 'Brit. Med. Journ.' Aug. 14, 1875, which gives in a short space all the precautions necessary for the administration of this anæsthetic, to which I need only add that in this as in all other anæsthetics it is very desirable to have the stomach empty—i.e. to enforce abstinence from food for about four hours whenever it is possible. On an emergency, however, this is of no great importance, but the patient will probably be troubled with vomiting during and after the operation.

Adminis-
tration of
ether.

'For the safe and efficient administration of ether-vapour for producing anæsthesia, several things are needful to be known and remembered, which are chiefly these :—

'1. That kind of ether should be used which is fittest for the purpose of inhalation, and this is the pure anhydrous washed ether, of specific gravity $\cdot 720$, free from alcohol and water. Robbins' "ether for local anæsthesia" is a dangerous compound for inhalation.

'2. The ether should be given in such a way that the inhalation may be commenced with a very weak vapour, which, after a few inspirations, can be rapidly increased in strength. If we begin with too powerful a vapour the air-passages are intolerant of it, and the patient resists the inhalation; but after a few moments' inhalation of a weak vapour, its strength can be increased without inconvenience and the patient rapidly brought under its influence. I think a cone of felt covered with thin mackintosh is the simplest and best apparatus for this purpose.

'3. Stimulants should not be administered before the inhalation. Ether is itself a stimulant, and can be safely given in cases where there is great depression; but, as Mr. Clover has pointed out, it is very undesirable to have alcohol in the stomach when ether is being inhaled.

'4. Whatever danger may belong to ether has relation to the respiratory function; the breathing should therefore be watched. And, I may add, it is desirable so to place the head of the patient that the saliva (the secretion of which is increased by the ether) may run out of the corner of the mouth rather than into the trachea.'

A more rapid method of administering ether has now come into extensive use, viz. to make the patient breathe into a closed receptacle between which and the mouthpiece is the vessel for the ether. Thus the patient breathes and re-breathes the same air, charged with ether, and of course warmed by his breathing—and thus a certain degree of asphyxia is mixed with the anæsthesia; though when this asphyxia becomes pronounced it is relieved by raising the apparatus from the face during one or two inspirations. The advantage of the method, besides its rapidity, is that the patient, breathing a warmed atmosphere, is not exposed to the danger of rapid bronchial congestion which sometimes, no doubt, attends the breathing of so irritating a vapour as ether. Sir J. Lister speaks of this as the 'close' method of giving ether, and says that it has a lowering effect on the circulation, and is on the whole more dangerous than the open method, from failure of the heart's action.

Another favourite plan at the present day, and, I think, often a convenient one, is to commence by the administration of nitrous oxide, and then maintain the anæsthesia by ether.

Chloroform is a more potent agent than ether, and takes less time to produce complete anæsthesia. The production of this state is marked by an absence of all voluntary motion and sensation and of reflex motion. As a test of this the eyelid is usually taken, and when the eyeball can be touched without any winking being induced the patient is reported as being fit for operation. The danger of anæsthesia consists in the risk that the poisonous effects thus manifested in the cerebro-spinal axis should extend to the central ganglia which preside over the functions of respiration and circulation, and thus cause the breathing to cease or the heart to become paralysed.

Adminis-
tration of
chloroform.

The methods of administering chloroform vary. Dr. Snow was led by the experiments he made to believe that 5 per cent. of chloroform in the inspired air is a proportion which could never produce danger, and he contrived an inhaler by means of which a certain surface of blotting-paper charged with chloroform is exposed to the contact of air at a definite temperature, so that the proportion of chloroform vapour could not, as he believed, rise above the limit of safety. Mr. Clover attained the same end more surely by mixing definite quantities of the vapour of chloroform and air in a large bag, carried over the shoulders and attached to the mask which covers the patient's mouth. But Sir J. Lister has, I think, shown satisfactorily that the evaporation from the usual quantity of chloroform poured on to a cloth never, even at high temperatures, rises above 4·5 per cent. (of which, of course, a great part is dissipated into the air),¹ and therefore that the method of administration with the cloth or handkerchief is quite as safe as that by Dr. Snow's inhaler, and *a fortiori* by other inhalers, which, in fact, are rather contrivances for economising chloroform than for regulating its dilution. Another advantage in this simple method is that the quantity of chloroform poured on to the hand-

¹ See 'Syst. of Surg.' 3rd ed. vol. iii. p. 601, *note*.

kerchief is a matter of secondary importance, while in Dr. Snow's inhaler it is essential to the mechanism that not more than ʒij. should ever be in the instrument at the same time. About ʒiss.—ʒij. then of the chloroform are to be poured on the handkerchief, and the patient is to be gradually accustomed to the taste and pungency of the vapour by holding it rather far from the face, and giving him occasional breaths of pure air, and when he is getting somewhat intoxicated pressing it rather more. A period of excitement, noise, and struggling usually, but not always, comes on, and then the patient sinks into a slumber, the limbs no longer resist when moved, he does not resent a pinch or prick with the knife, and the eye is insensible. Then the operation may be begun. In the last edition of his essay, Sir J. Lister describes a slightly different method as more convenient, and probably safer, both as producing anæsthesia with a lower percentage of chloroform, and as necessitating more constant attention. This consists in covering the patient's face, from the root of the nose to the chin, either with a mask of flannel or with a cap made of the corner of a towel about nine inches square, and moistening it constantly with small quantities of chloroform. In this way anæsthesia can be produced and maintained equably for any length of time with about $2\frac{1}{2}$ per cent. (by volume) of chloroform; and this Sir J. Lister holds to be well within the limit of perfect safety, and to constitute an approach to what Paul Bert has spoken of as the 'zone maniable,' i.e. an atmosphere in which the patient might be left for an unlimited time in safety without any attention.¹ Sir J. Lister is a strong advocate of the theory that all that is necessary for safety in chloroform inhalation is to watch the breathing, and, when any lividity of the face occurs, or any laryngeal stertor, to pull the tongue out of the mouth with a pair of forceps sufficiently far to open the larynx freely² and allow the patient to breathe naturally, withdrawing the cloth till the indications of returning sensibility necessitate the readministration of the vapour. And doubtless these precautions would reduce the mortality after chloroform materially. Still there have been many deaths resulting, as far as we can judge, from sudden failure of the heart's action, under the hands of persons quite aware of the importance of watching the respiration, and whom we have no ground for charging with negligence; and, in fact, Sir J. Lister allows that there may be varying idiosyncrasies in respect of chloroform. The only death from chloroform that I ever happened to witness was in a young man of perfectly healthy appearance, and in whom an experienced chloroformist certainly noticed no obstruction to the respiration before the failure of pulse which proved at once fatal. It seems, therefore, safest to watch both the pulse and the respiration, the latter most narrowly, as it is the side from which the danger most commonly occurs. On the first symptom of failure of the pulse the chloroform must be suspended, if the galvanic battery is at hand it should be applied, and the breast should be well slapped with cold towels, while hot affusion is practised to the head. When the respiration is suspended, if forcible traction on the tongue fails to restore it, artificial respiration should be practised, the tongue being still held forward.

¹ For the discussion of this question of the 'zone maniable' I must refer to Sir J. Lister's essay, pp. 615 et seq.

² I must refer the reader to Sir J. Lister's article (p. 604) for his theory of the effect on the larynx of drawing forward the tongue, and for his views of the nature and symptoms of laryngeal obstruction. The main point in practice is to recollect that defective breathing comes on very insidiously and suddenly, and may be relieved by forcible traction on the tongue.

The question of the relative safety of ether and chloroform is one on which I have no wish to dogmatise, but I have used ether with great comfort for many years, and had never seen any but the most trivial inconvenience from it, such as blistering of the lips from evaporation, and cough or irritation of the bronchial tubes from its pungency, till the year 1884, when a fatal case occurred in my own practice.¹ During the same time I have also employed chloroform perhaps as commonly, and have been so fortunate as to escape any fatal accident from this in my own practice, and, as I have said above, never to see more than one death from it. But I think we can hardly resist the unanimous opinion of the American surgeons, founded on nearly thirty years of extensive experience, as to the relative safety of ether, and if so we should only employ chloroform in exceptional cases. There are some persons (chiefly old toppers) in whom ether produces such excitement, or whose bronchial membrane is so sensitive, that it has to be given up, and with them if any anæsthetic is used it should be chloroform. Chloroform seems also perfectly safe in childhood, but so is ether also.²

Relative safety of ether and chloroform.

An idea seems still to prevail that anæsthesia is especially dangerous in disease of the heart, but I think this is an error. It is true that in extensive disease of the heart any excitement may prove fatal, and so may of course that of taking ether or chloroform. But then the shock of the operation without an anæsthetic is far more likely to cause death in that condition, so that if any operation is required it seems safer to perform it under anæsthesia than without.³ In themselves both ether and chloroform are stimulants, especially the former.⁴

Anæsthetics in heart-disease.

Bichloride of methylene is an anæsthetic which possesses the advantages of producing insensibility very quickly, and of not causing any subsequent sickness or discomfort. The patient also recovers very rapidly from its effects. On account of the immunity from sickness it is much used for ovariectomy ; and on account of the rapidity with which persons can be brought under its influence, it is reported to be much used in some eye institutions where many operations are performed. But ether seems, with proper precautions, almost as free from after-vomiting, and the saving of time in producing anæsthesia is a poor reason for employing an agent which seems to be more dangerous than the other anæsthetics.⁵

Bichloride of methylene.

Nitrous oxide, or laughing gas, has now been made available for practical

Nitrous oxide.

¹ 'Brit. Med. Journ.' March 15, 1884.

² The deaths which have been recorded from ether are certainly very few in number. One which occurred a few years ago at Lincoln attracted much attention. The lady was a member of a surgeon's household, and the ether was administered by a professional anæsthetist. What Sir J. Lister says seems probable enough, that deaths occur from ether, not on the table, but soon afterwards, from rapidly increasing congestion of the lungs, which, as they do not occur during the operation, escape record as deaths from anæsthesia, though they are so in reality.

³ I have already alluded to a death which I saw from chloroform in a perfectly healthy person, in whom post-mortem examination detected no visceral disease of any kind. The next patient brought into the operating-theatre was one of my own—an old man with extensive disease of the heart. He was placed under chloroform and the operation completed without any bad symptoms. A few days afterwards he fell down dead while walking across the ward.—'Path. Trans.' vol. xv. p. 69.

⁴ 'An amputation performed under chloroform,' says Sir J. Lister, 'has often the effect of improving instead of lowering the pulse,' and he gives a striking example of this.

⁵ I ought not to omit stating, however, that Sir Spencer Wells always uses this anæsthetic, and stated in his lectures at the College of Surgeons that he had never seen the slightest trouble from it.

purposes by giving it freely and pure, i.e. unmixed with air. In this way it does not excite, but produces at once a condition of complete insensibility. The patient becomes entirely comatose, the whole blood is unoxygenated, so that the surface is of a dark livid colour, and the blood which exudes from an incision quite black. The condition of the patient appears most alarming, but in two or three minutes the colour returns and he recovers, with no symptoms whatever, and no traces of the alarming state in which he has been. During those two or three minutes any operation can be performed with as complete absence of sensation as under any other anæsthetic. And as the administration can be repeated, long operations may be performed without any remembrance on the part of the patient. But it is doubtful whether this would not be as dangerous as any other anæsthetic, and it is certainly much less convenient, so that nitrous oxide is now reserved for very short operations, like tooth-drawing, or other transient but painful proceedings. The gas is stored under pressure in a liquid state, and on the removal of the stopper from the bottle a certain quantity resumes its gaseous condition and fills a bag which is screwed on to the bottle, and contains enough for one administration. The bag is then attached to the mouth-piece.

MEANS OF RESTRAINING HÆMORRHAGE.

HÆMORRHAGE is restrained in amputations, and other operations on the limbs, by the *tourniquet*, a contrivance whereby pressure is made directly on the main artery, and also by means of a circular strap on the whole limb. The common tourniquet consists of a pad which is pressed down by a screw, and the screw is attached to a large strap which encircles the limb, and thus as the screw is pressed down it tightens the strap and makes pressure equally on the limb all round. The pad is either attached to the screw, or is placed below it, secured also by a circular webbing-strap, or is replaced by a piece of roller laid on the artery. Care should be taken so to direct the pressure as to compress the artery against the subjacent bone. Instead of the screw tourniquet, a solid india-rubber cord, which fits into an ebonite or wooden compress and is held by it, is now largely employed. It possesses the advantages of being more readily and easily applied and of being very portable, but it is somewhat liable to slip. These are most efficient methods of controlling hæmorrhage, but produce, of course, considerable venous engorgement, and cannot be tolerated for any length of time. The Italian, Signorini's, or the horse-shoe tourniquet, is an arch of metal larger than the limb, having an expanded piece to rest against the side opposite the artery, while a screw carrying a pad is directed against the artery from the opposite end of the arch. This makes no circular compression of the limb, and does not produce venous congestion except by the unavoidable pressure on the main vein accompanying the artery. All the aneurism-compressors are made on this principle, as well as the aortic tourniquet for amputation at the hip.

Some surgeons are fond of using finger-pressure on the artery instead of a tourniquet, and this is necessary in many situations, as in amputations performed so high that there is no room for the tourniquet. Whenever the tourniquet can be applied I believe it is much better, as saving the loss of blood. In making digital compression, the assistant who takes charge of the artery should take a sufficient grasp of the limb to steady his thumb, which

The common, or Petit's, tourniquet.

The horse-shoe tourniquet.

Digital pressure.

is to be firmly pressed on the artery in the proper direction, and supported by pressure with the thumb or fingers of the opposite hand. When that thumb gets quite tired the other is to be rapidly substituted for it, and supported in the same way. Davy's lever is another method of making pressure on a single vessel. It is described in the section on amputation at the hip.

The tourniquet does not render the parts bloodless; in fact, it causes venous congestion; but complete absence of blood in the parts divided may be secured by the application of an elastic bandage as recommended by Prof. Esmarch.¹ A bandage consisting of stout india-rubber tissue is rolled round the limb exactly as a spiral roller is. No great force need be employed, but the constant resilience of the elastic tissue will squeeze the blood out. In order to hinder its return a stout piece of elastic tubing is passed twice round the limb just below the upper edge of the bandage and secured by hooks. Then the bandage is unwound from the limb, which is seen to be perfectly pale and bloodless, and, when cut into, its tissues are as free from blood as in the dead subject. Even the bones are sometimes entirely empty of blood. The benefits of this method are great during any operation in which the oozing from the parts is annoying, i.e. all dissecting operations; and they are also striking in excisions, since the precise limits of the disease can be seen as well as in the post-mortem room. In cases also of traumatic aneurism, of wound of the artery, and of the old operation for aneurism, the method seems applicable. I am not sure that blood is really saved by it, for in many cases the very free oozing which takes place as soon as the circular tube is removed pretty nearly balances what would have escaped if the operation had been performed in the usual way. Riedinger refers to a patient operated on by Linhart for irritable stumps, following double amputation above the malleoli for frostbite, where secondary amputation was resorted to in each instance; but on the right limb the elastic bandage was applied, while digital compression was adopted when the left stump was removed. The blood lost during and after the operation, before the flaps were approximated, was carefully weighed, and found to be $2\frac{1}{2}$ oz. in the case of the right, and $1\frac{1}{2}$ oz. in that of the left.² In regard to the amount of blood lost to the system, however, he says this calculation is not absolutely correct, for in the small stump removed from the left leg there was a very small amount of blood that was not returned to the trunk, by the mere elevation and rubbing employed before digital compression was begun. This could not have been much, however, for the stumps contained but a small amount of blood, and according to Bruns, about thirty per cent. of the blood in an extremity remains after the elastic constriction has been thoroughly applied. I have not seen any prevalence of sloughing after operations so performed, nor have I realised the dangers of pressing the products of suppuration up the veins, or producing internal congestion by squeezing the blood back; in fact, I believe them to be imaginary, but further experience is necessary to show us what is the real value of the

Esmarch's
bandage.

¹ Esmarch's method of rendering a limb bloodless by the constant pressure of an elastic bandage is altogether different from the long-known method of applying a common bandage before putting on the tourniquet, which was so far from rendering the parts bloodless that it was found hardly worth the trouble of application, and fell out of use.

² 'Deutsche Zeitschrift für Chirur.' VII. p. 466. In the same paper an ingenious speculation as to the possibility of staying the hæmorrhage by galvanism will be found. See also a paper by Dr. Roberts of Philadelphia in 'New York Arch. of Clin. Surg.' vol. i. p. 176.

method. The attempts to show that the mortality after operations so performed is lessened by the method are quite premature. After the constricting band is removed, a few minutes should be allowed for the bleeding to subside under the use of cold water, after all the main vessels have been tied, and with this precaution I have not met with any secondary or reactionary hæmorrhage.

Prof. Esmarch adopts a different method of stopping the oozing which follows the removal of the band. In amputations he unites the wound by deep sutures of catgut, places a drainage-tube in the deepest part of the cavity, applies 'a retentive dressing,' and places the limb in a vertical position, before removing the band. The stump is then kept vertical for half an hour after the patient has been put back in bed. A slight modification of the same plan is used in excisions and other operations.—'Lond. Med. Rec.' Nov. 15, 1880.

We have now to treat of the strictly manipulative part of operative surgery. All the surgical operations, however, which are employed only in special parts of the body have been spoken of above in their appropriate places, as lithotomy with diseases of the urinary organs, tracheotomy with those of the larynx, &c. It remains to speak of plastic surgery, amputations, and excisions.

PLASTIC SURGERY.

THE operations of plastic surgery are directed to filling up the gaps left by destruction of the nose, and by the incisions made in dividing or excising cicatrices, or in refreshing the edges of unnatural clefts. Some of these operations, especially those of the latter class, have been spoken of in previous pages. Such are the operations for harelip, fissured palate, and ruptured perinæum. The principle of this class of plastic operations is to bring the edges of the cleft into apposition by means of some form of suture, and obviate tension, if necessary, by incisions. Incisions, however, are not always necessary. Thus, in harelip, no incisions are, as a general rule, required. If any are so, they are made along the border of the nose. In fissure of the soft palate the object of the incisions is chiefly to divide the muscles, while in that of the hard palate free lateral incisions are made through the muco-periosteal structures. In ruptured perinæum and in recto-vaginal fistula incisions are usually superfluous, but sometimes the sphincter may require division. In vesico-vaginal fistula it is generally impossible to place incisions so as to give any assistance to the sutures, but occasionally such incisions may be made through cicatrices in the wall of the vagina.

Lateral
incisions
in plastic
operations.

Transplan-
tation
of skin.

The operations for restoring the nose and for contracted cicatrix involve the process of transplantation of skin,¹ which is rarely required in the operations for the closure of fistulæ. Up to the present time I think it may be said with truth that nothing except the skin has been successfully transplanted; but attempts are being made to transplant periosteum which may form the nidus of bone (osteoplasty), and if such attempts succeed they might much

¹ These flaps are always spoken of as being formed of skin, but in truth as much as possible of the subcutaneous tissue also should always be taken up along with the skin. The more fat and vessels can be raised with the skin, the less risk is there that the skin will slough.

extend the practice of plastic surgery, and especially in the operation of nose-making.

Two ways of transplanting skin are recognised, viz. by displacement or gliding, and by torsion. In the former the piece of skin is dissected up, left attached to the surrounding parts by a broad isthmus, and then its direction is so shifted that it can be fitted into the part where it is intended to lie. The neck, or isthmus, remains permanently, and the puckering or twisting caused by the displacement gradually disappears. In the method by torsion the position of the flap of skin is entirely changed (for instance, it is brought down from the forehead to the nose), and for this purpose it is left attached by a neck as slender as is consistent with the maintenance of vitality, which neck is twisted so as to permit of an entire change of position. Then the edges of the skin are stitched to those of the cleft, and after a sufficient time, when the transplanted skin has fully received the elements of vitality from the neighbouring parts into which it was transplanted, the neck is divided and that part also of the transplanted flap inserted into the edge of the cleft, so that now the flap is permanently fixed in its novel position. Such transplantation can be effected from one part of the body to another, as from the arm to the nose, or from the thigh to the hand, the parts being kept in apposition by some mechanism until the transplanted flap has grown into the cleft.

By displacement; 'auto-plastic parglissement.'

By torsion; veritable transplantation.

Recently attempts have been made to transplant bodily portions of skin which have been removed entirely from their natural position. Thus a piece of skin has been dissected out of the arm, or taken from a limb just amputated, and fitted into a bed prepared for it in the face or eyelid. And I believe some of these attempts have succeeded, though the only one which I have seen failed. The skin in such cases is to be cut a little larger than the gap which it is to fill, carefully freed from all fat and cellular tissue, shaped as rapidly as possible to the gap, and united by a number of fine sutures. It must then be covered up warm, and left quietly in position for several days.

The operation of restoring a nose which has been cut off, or lost by lupus or syphilis, is one which is little in favour with most surgeons of the present day, since it is found that the new nose being formed only of skin, generally either withers away or remains flat on the face, and in either case the patient's appearance is not improved. Besides, in the usual method of operation, the flap being taken from the forehead, another scar is added to the previous deformity.

Rhino-plasty, or restoration of the nose.

The common plan, or the Indian operation, is to take a piece of paper, gutta-percha, or leather, and adapt it to the stump of the nose so as to form as shapely a feature as may be; then lay this pattern on the forehead, and cut a flap of skin accordingly, leaving it attached by as broad a neck as possible to the bridge of the nose. In cutting this or any other flap, allowance must be made for the shrinking of the skin, so that the flap must always exceed the pattern a little in all directions. In order to form the columella a little tongue is left on the middle of what was the upper border of the flap, and which when it is twisted becomes the lower. The edges of the cleft should be refreshed before cutting the flap, and the latter brought down and attached as rapidly as possible in its new position by several points of silver suture. The new nose must be supported in position by a plug, or two plugs of suitable size and shape, and of some non-absorbing material, and supported on the plug by a pad and bandage loosely

applied. When the union of the edges is complete, and the transplanted flap perfectly warm and full, the neck may be divided, the rest of the cleft over the bridge of the nose pared, and the raw surface left by the division of the neck implanted there. The plug must be changed from time to time, but great care is required in doing this, and it should be put off as long as possible after the operation in order to leave the parts quiet till the edges have united firmly.

The same operation is also still sometimes done after the method of Tagliacotius by transplanting the flap from the patient's arm. An apparatus must first be manufactured which will keep the arm in comfortable apposition with the face; and then the flap is to be marked out and raised, much as in the Indian operation; but here the surgeon has the advantage that he can make a neck of any size that he wishes, so that possibly the flap is less liable to slough. The restrained position, however, is a great inconvenience, and necessitates the section of the neck as early as possible.¹

Rhinoplasty is very liable to failure from sloughing of the flap, from want of union of the edge (especially when the tissues are cicatricial from old lupus), from erysipelas, and from secondary hæmorrhage. It is, therefore, not an operation which the surgeon should recommend.² Mr. Skey, who had much experience in it, says: 'Let it be the patient who urges the operation.' And in the present day, when so many new materials are in use for masks, it will be found that a person who can command the necessary assistance will derive much more advantage from the services of the mechanic than the surgeon. I once met with a patient who managed to make for herself a far better nose, in some way which she would not explain, than any which rhinoplasty could have provided.

Operations
for con-
tracted
cicatrix.

The contraction of scars, especially those of burns, frequently leads to terrible distortion, particularly in the neck and at the flexures of the joints, as the axilla and the fingers. As I have said above (p. 119), much of this could be avoided by careful extension during the healing process, and by promoting rapid union; but in many cases, especially in children, some amount of contraction is often inevitable.

It is very difficult to obtain permanently satisfactory results by operation in these cases. Consequently every attempt should be made to stretch the cicatrix by mechanical means before any plastic proceeding is undertaken. When, however, the latter becomes necessary, several different measures present themselves for selection. The simplest is merely to divide the cicatrix, put the parts forcibly on the stretch, and let the gap fill up by granulation, keeping the apparatus constantly applied till the scar is completed, which may be hastened by skin-grafting. I have seen this method succeed in deformity from scarring in the limbs, but in the neck I believe it always fails. The gap left by the division of the cicatrix may be filled at once by

¹ An interesting example of the successful performance of the Tagliacotian operation will be found recorded by Sir W. MacCormac, in the 'Clin. Soc. Trans.' vol. x. p. 181.

² Some novel attempts have recently been made to obviate the many causes of failure in rhinoplasty and other operations by transplantation. Thus Dr. Hardie, of Manchester, has transplanted the distal phalanx of one of the fingers into the nose in order to provide a bony base for the transplanted flaps ('Brit. Med. Journal,' Sept. 25, 1875); and Dr. Wolfe, of Glasgow, has even gone so far as to assert that no vascular connection with its original neighbourhood is necessary for the transplanted flap, but that the skin may be simply cut from the arm or other part and inserted into the face, and will adhere and grow there (ibid. Sept. 18, 1875).

a flap cut from the thorax or from the back of the neck and made to glide on its base, so as to be attached to the edges of the divided scar, or rather to the line of division which is carried between the scar and the integument supposed to be healthy.¹ But the objection to this plan is that the edges of the cleft left by such divisions are always more or less cicatricial, and the base of the cleft is also unnatural in structure, so that union cannot take place rapidly. Now, it is on the occurrence of rapid union that all prospect of success in plastic proceedings depends. A somewhat more satisfactory result may be hoped for if all the cicatrix can be extirpated, but this is usually impracticable in the neck. The result of such operations, as far as I have seen (and I have performed and seen many such), has been that even in those which seemed most successful at first, where almost the whole flap united kindly and the deformity was at first greatly lessened, some part remained long unhealed, and at this point a band of cicatrix ultimately formed which subsequently, in spite of the best efforts of the surgeon, contracted slowly, and to a great extent reproduced the deformity.

Again, the deformity of the lip is a very difficult feature in contractions of the neck. The lower lip gets drawn down, presenting its mucous surface externally, and causing great distress from dribbling of saliva as well as distorting the other features. This is best dealt with by freeing the reversed lip from the jaw-bone as well as possible with the knife, refreshing its upper edge, and drawing over it two pieces taken from the cheek and corners of the mouth. These pieces are cut by a line sloping away on either side from the centre of the lower lip to the base of the jaw, and continued along that bone as far as may be necessary, but so as not to wound the facial artery. These two pieces are movable enough to unite with each other in the middle line, while their bases are sewn into the refreshed edge of the lower lip. Similar operations may also be performed in cases where the upper or lower lip has been destroyed by cancer or injury.

Cheilo-plasty.

A somewhat rare deformity is that in which the fingers are united by a fold of skin either in their whole extent or for some distance in front of the natural cleft. The same deformity is found in the toes, but it is of no consequence there. In the hand, however, it so materially limits the movements that it is of great importance to remedy it if possible; but it is very difficult. The difficulty consists in the great tendency to cicatrization commencing at the posterior angle of the wound, in the situation of the natural cleft. If this does commence, it will surely, though gradually, extend forwards till the web is reproduced and tighter than before, because cicatricial. Of a great number of methods which have been employed in the treatment of webbed fingers I will only mention two. One is to procure a permanent opening in the situation of the natural cleft by the insertion of a ring—much as the hole in a lady's ear is kept open; and when this opening is completely and permanently established to enlarge it by the insertion of tents or wedges increasing in size. A large separation being thus made at the cleft, the web in front can be divided gradually by elastic pressure; or else, after the hole has been established, the web in front is divided close to one of the fingers, and the two flaps thus obtained are united together to cover the other finger, for which they are amply sufficient. Then a covering is obtained for the denuded finger out of some distant part of the body—say the outer side of the thigh. A flap is dissected up and left attached by both its ends, and the

Webbed fingers and toes.

¹ Mr. Butcher has shown how much assistance may sometimes be afforded in these cases by subcutaneous division of the cicatricial bands around the chief scar.

finger is thrust in below it—much as the hand is thrust into the pocket—and the edges of the flap united to those of the cleft. When union has taken place the ends are divided, the hand released, and the cut ends implanted.

AMPUTATIONS.

General
observa-
tions.

THE chief indications in amputation are—1. To remove the whole of the parts which are diseased or injured beyond the prospect of recovery. 2. To avoid all unnecessary loss of blood. 3. To cut flaps of proper shape and long enough to cover the bones without any tension. It might, perhaps, be added that the main nerves ought never to be left so long as to be exposed to pressure by the ends of the bones.

The chief methods of amputation are as follows :—

Circular
amputa-
tion.

The *circular*, in which a cut is made all round the limb through the skin and fat, which are thrown back from the muscles something like the cuff of a sleeve,¹ then the muscles are divided by one or more circular sweeps down to the bone, then all the soft parts are retracted from the bone or bones, and the latter are sawn about an inch above the part first exposed by the division of the muscles.

Retractors.

In all kinds of amputation retractors are sometimes wanted, but more generally in the circular. They should never be required if the parts are healthy, but may be indispensable when they are stiff from œdema or inflammation. For the thigh or arm they are usually made of two plates of metal, each having a handle at each end and a semicircular notch in the upper edge. One of these is placed above the bone, the other below. The two notches form a hole through which the bone passes, and the soft parts are then pulled forcibly upwards, the saw being applied just below the retractors. A split piece of stout cloth will answer the same purpose. When there are two bones a tongue must be torn in the cloth and passed between the bones; the ends are then crossed and the cloth drawn upwards.

Flap
amputa-
tion.

Flap amputations are now more in use than circular. The flaps are cut in two ways, by transfixion or incision. In the former plan, when the flaps are made as is usual in front and behind the limb (antero-posterior flaps), the knife is passed as near as possible in front of the bone, or bones, just below the place where the saw is to be applied. Then the knife is carried downwards and outwards, cutting as long an anterior flap as necessary; the same thing is done behind, the flaps are drawn up, the bones cleaned a little higher up, and the saw applied. The same operation is sometimes done on either side of the bone (lateral flaps), chiefly in the upper arm. In this way the flaps must be formed of all the tissues of the limb; but if the operator wishes to take skin only, or in varying proportion to the muscles, he must make his flaps by incision, carrying the knife along any lines which he may find suitable, and then raising the parts from without inwards, and taking care to take an ample allowance of fat and other subcutaneous tissues along with the skin. The flaps formed by transfixion must be oval, those formed by incision may be of any shape. They may also be formed entirely of skin, the muscles being divided straight down to the bone; or they may include all the tissues of the limb (as in Teale's amputation); or, as is now very commonly done, the flaps of skin having been thrown back, the muscles may

¹ This dissection is omitted by some operators, who merely divide all the parts down to the bone by successive circular cuts, while an assistant retracts the parts as they are divided.

be divided as in the circular amputation—an operation usually spoken of as ‘the modified flap amputation.’ I shall endeavour as well as my space allows to illustrate each of these methods of operating in speaking of the amputations of different members, in doing which I shall describe the method which seems best adapted to each, though in all of them it is quite feasible, nay, is necessary sometimes, to adopt a method the farthest possible from the one here recommended. For instance, in amputating at the shoulder the flap amputation by transfixion is the best; but it is often necessary to cut the flaps by incision, and even the circular amputation may be performed.

The instruments required for amputation are very simple. In the present day many amputations are performed with a simple scalpel rather larger than a dissecting knife, but generally an amputating knife is employed. This should have a sharp point and a fine narrow blade,¹ and its length should be proportioned to the size of the limb. The shorter it is the easier it is to manage, but for transfixion operations its length must considerably exceed the thickness of the limb. For cleaning the bones when there are two, a small double-edged catlin is convenient. The back of this is pressed against the farther bone, dividing all the soft tissues and periosteum, then the point is thrust between the bones until their periosteum is also completely divided

Instruments for amputation.

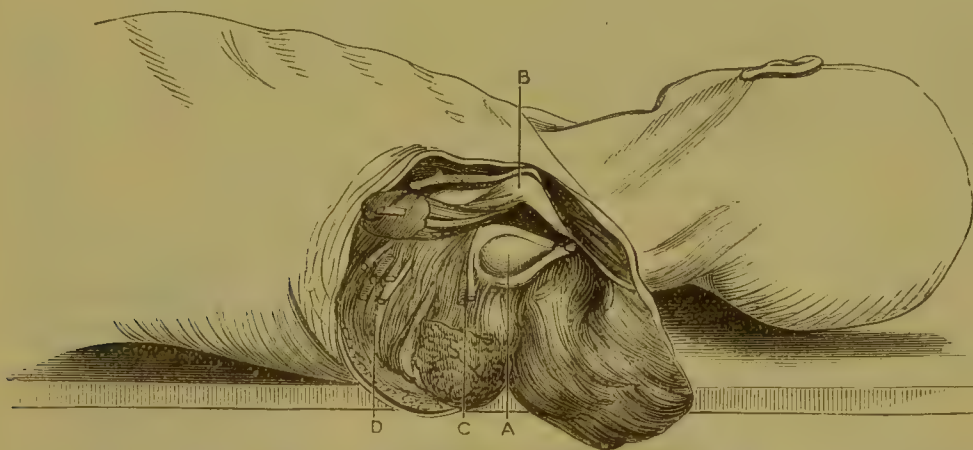


FIG. 412. The stump of an amputation at the shoulder joint. A, the glenoid cavity, the long tendon of the biceps, seen at its upper part; B, the coracoid process with the coraco-brachialis muscle and short head of the biceps; C, the posterior circumflex artery and circumflex nerve; D, the axillary vessels and brachial plexus. Above the letter A is seen the mass of the deltoid; above the letter C the triceps muscle. In the depression between the deltoid and glenoid cavity are the tendons passing to the great tuberosity. That of the subscapularis is in the depression between the glenoid cavity and coracoid process. Above the coracoid process is seen the pectoralis major.

where their surfaces are opposed, then the point is disengaged by pressing the front of the blade on the nearer bone, and so its edge is drawn up the nearer bone till it comes to the point from which it started. A peculiar manipulation (called the figure of 8) is sometimes taught for doing this, but it requires really no special instruction. The amputating saw, a stout strong-backed saw, should be in readiness, and a pair of sharp bone-forceps to cut off any splinter that may be left projecting; and if the amputation is performed in a case of fracture, the lion-forceps are required to hold the end of the fractured bone while it is sawn smooth above. A common scalpel, tenacula, ligatures, and the contents of the pocket case complete the armamentarium.

After amputation the wound is to be dressed as prescribed in Chapter I., a piece of drainage-tube being passed through the deep part of the stump, in order to drain off the abundant sero-sanguineous discharge which usually

Dressing the stump.

¹ The old ‘circular’ knife with a round point is now very rarely used.

collects in the cavity if it is tightly sewn up, and gives rise to suppuration. If the stump is long enough the patient will derive much comfort from its being placed on a splint and lightly bandaged, and the splint may be slung if required. When the flaps are necessarily left somewhat deficient in length, or when they retract afterwards so as to threaten to leave a conical stump, much benefit may be obtained by careful bandaging, the parts being kept well drawn forward while the bandage is being applied; and still more advantage is derived from the application of continuous traction by means of a weight acting on a stirrup of strapping, which has been secured to the stump by one or two circular strips, a few inches above the incision.

Amputa-
tion at the
shoulder
joint.

Amputation at the shoulder joint is best performed by transfixing, and cutting the flaps from within outwards. The situation of the joint having been already fixed in the surgeon's mind, he gets an assistant to compress the subclavian artery, while a second manages the arm for him, holding it at first at right angles to the patient's body. The operator, standing behind the patient, enters the knife just behind the posterior flap of the axilla, and brings its point out close to the coracoid process. It is quite easy to open the joint with the point of the knife as it passes across. Then a large flap is cut out of the deltoid muscle, which is retracted by the second assistant, who now brings the arm down to the side and pushes the head of the bone up out of the joint as the operator passes the heel of the knife round it. The knife having now quite severed the articulation, the second assistant again holds the arm perpendicular to the body, while the surgeon brings his knife parallel with the humerus, and cuts a short flap out of the parts internal to it in the axilla. One of the assistants or the operator himself follows the knife with the fingers inside the flap to catch the axillary artery between the fingers and thumb in case the pressure on the subclavian is insufficient. On an emergency (such as sometimes occurs in war) the pressure on the subclavian may be dispensed with, and the operation can be and has been done without the aid of any trained assistant at all, the operator being aided only by a man who manages the arm for him and helps him to tie the vessels. If it is found more convenient, the surgeon in operating on the right arm may stand in front of the patient, and cut the anterior flap by entering the point of the knife by the side of the coracoid process, and bringing it out near the posterior flap of the axilla.

There are many other ways in which this amputation can be performed, by cutting flaps from the skin inwards, by a modified circular method, or by using any tissue left uninjured to cover the glenoid cavity. I have seen cases in which the tissues were so far torn off the arm and scapula that even this was impossible, yet which healed well by granulation, and left really little to desire. Amputation at the shoulder joint is by far the most successful of all the major operations; but it should not be performed except in cases of evident necessity, since any movable stump which can be formed out of the arm, however short, will be of some use to the patient.

Amputa-
tion of the
arm.

Amputation through the continuity of the humerus can be performed in any way that the operator fancies, or that the nature of the disease or injury points out as advisable. One of the best methods, I think, is the combination of skin-flaps with a circular incision of the muscles. The tourniquet may be put on near the axilla, or Esmarch's bandage may be applied, or the axillary artery may be held by an assistant. The operation is now comparatively rarely performed, chiefly in cases of complicated injury in

which it is impossible to preserve the limb, or cases of malignant disease. In the former case very few vessels will require ligature, probably the brachial and superior profunda will be the only ones (Fig. 413). In cases of rapidly growing tumour, of course, the smaller arteries will have become enlarged, and must be tied.

In some rare cases amputation has been performed through the elbow joint. There would be no difficulty in fashioning the flaps, but the opportunity for performing the operation must be very rare, for any part of the forearm which can be preserved would be useful, and if the whole forearm is destroyed the humerus is also probably injured, and its end must be removed. In the only case in which I have as yet performed this amputation I made a long skin-flap from the back of the limb, and turned it over to meet the parts in front which were divided by a transverse cut. The resulting stump was an excellent one; and I have seen excellent stumps of this amputation from the practice of other surgeons.

Through the elbow.

Amputation of the forearm is a very common operation, and is performed on account of laceration of the hand, or of caries of the wrist, or malignant tumour.

Amputation of the forearm.

The rectangular or Teale's amputation in this part of the limb is a very good method, for the chief difficulty in amputation of the forearm is caused by the numerous



FIG. 413. Diagram of a section of the upper arm, showing the parts as they would be seen in a circular amputation.

A, the brachial vessels, having the median nerve in front of the artery, and the ulnar at some distance below it, along with which the inferior profunda artery runs; B, the basilic vein with the internal cutaneous nerve; C, the humerus, lying close to which are seen the musculospiral nerve in the substance of the triceps muscle, and the superior profunda vessels along with it. In front of the humerus is seen the musculo-cutaneous nerve lying between the biceps and brachialis anticus, and in the superficial cellular tissue the cephalic vein. Muscular vessels lying in the substance of the three muscles will probably require ligature.

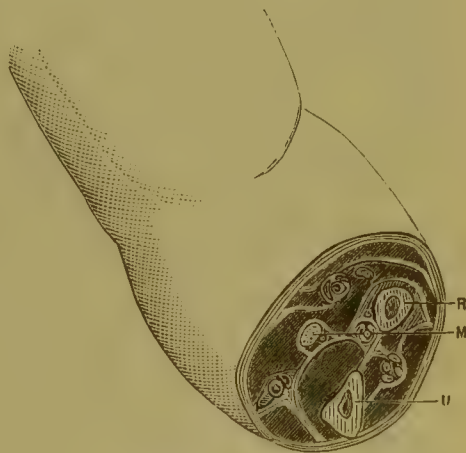


FIG. 414. Section of the forearm about the middle, radius, with the radial vessels and nerve in front of it; M, median nerve, which is sometimes accompanied by a vessel requiring ligature; U, ulna overlapped by the fl. prof. digitorum, and having the ulnar vessels and nerve in front of it. The interosseous membrane is seen between the bones, and, lying on it, the anterior interosseous vessels. The posterior interosseous vessels are seen between the deep and superficial layers of muscles at the back.

tendons (especially near the wrist) which are liable to be cut irregularly, and so interfere with a perfect result. In the rectangular operation these are divided straight across, and the flaps formed are more regular. I usually make the long flap in the rectangular amputation of the forearm in front; preferring this to Mr. Teale's original method, in which the long flap was made behind—a method still followed at Leeds. The long anterior flap gives, I think, a better covering for the bones, and a more equable

thickness of parts in the flap. Either method, however, may be adopted. But many other plans are in use; a modified flap—i.e. skin-flaps with circular incision of the muscles—or, on the other hand, a circular sleeve of skin turned back, and then short flaps cut out of the muscles by passing the catlin in front of the bones, below the two main arteries, and cutting outwards, and then making a similar small flap behind (as recommended by Sir P. Hewett), or the common circular operation, will all give good results when carefully executed. If any tendons project irregularly they must be trimmed off before the flaps are adjusted. The position of the vessels can be seen from the annexed diagram (Fig. 414).

In some rare cases the whole hand is removed at the wrist. This may be done by cutting two tolerably equal semicircular flaps back and front from the skin inwards, or by making one long flap either from the dorsal or palmar surface. In two instances in which I have performed this operation by a long anterior or palmar flap, the result has been a most excellent stump. A large quadrangular flap is made, commencing at one styloid process and terminating at the other, and extending almost to the transverse fold in the palm opposite the heads of the metacarpal bones. The flap, including everything down to the flexor tendons, is then raised, and a circular sweep made round the back of the wrist, the ligaments and tendons divided, and the hand removed. The median and ulnar nerves are now to be removed from the flap, leaving the superficial palmar arch intact and the edges of the flaps united. If the pisiform or unciform process is inconveniently prominent it may be cut off.

The fingers are constantly amputated at any of their three joints, sometimes through the continuity of one of the phalanges, and more frequently through the metacarpal bone, the head of which is removed along with the finger. The two terminal phalanges are best amputated by cutting pretty straight into the articulation on its dorsal aspect, corresponding to the central fold of the skin on this side of the joint, and then passing the knife through the joint and shaping a long flap out of the tissues on the palmar surface. In amputating the knuckle it is important in a labouring man to preserve the head of the metacarpal bone. Those who study appearances sometimes recommend its removal in persons who are not called upon for manual labour; but this weakens the hand so by the section of the transverse ligament and other structures, that it seems to me better always to preserve the head of the bone if possible, though the gap between the two fingers is no doubt an ugly deformity. In the dissecting-room the amputation may be accomplished with a single sweep of the knife. The knife should be long and thin, but stout. The finger to be removed (say the middle) is seized and drawn to the ulnar side, the heel of the knife is laid on its radial side, at the anterior end of the incision, and carried on with a sawing motion backwards till it arrives at the position of the joint. It is now turned transversely through the joint, and then forwards to cut out the flap on the ulnar side. The various exigencies of injury and disease often render this operation impracticable on the living subject, and the flaps must be shaped as the operator best can, but inclining to this model. If the head of the metacarpal bone is to be removed, the incision must be prolonged sufficiently backwards to allow of the bone being cleaned and the cutting forceps applied.

The thumb is very rarely amputated, since its preservation, or that of any part of it, is so useful as a *point d'appui* to the fingers, even if it is itself immovable, that surgeons generally leave cases of injury of the thumb

Amputa-
tion at the
wrist.

Amputa-
tion of the
fingers.

Amputa-
tion of the
thumb.

to nature; and in cases of diseased joints or phalanges the expectant treatment is still more plainly imperative. The thumb may be amputated at its joint with the trapezium bone by carrying an incision forward on the dorsal aspect of the metacarpal bone from the position of the joint, then making it include the metacarpo-phalangeal joint in an oval manner, and so returning to the point from which it started. Thus an ample covering is secured for the flap, and no incision made in the palm. The thumb, being freely divided from the fold uniting it to the forefinger, is lifted up, the knife passed below its metacarpal bone, separating it from the palmar muscles, and then by dividing the ligaments which unite it to the trapezium the whole member is removed; or palmar and dorsal flaps may be formed by passing a long bistoury in front of the thumb from near the situation of the joint to the fold between the thumb and forefinger, and then cutting out a large flap from the mass of muscles of the thumb. The joint, which is now exposed, is divided, and a smaller flap made from the dorsum. The radial artery is sometimes divided in the operation, though by carefully keeping the knife close to the bone as the operator passes through the joint this may be avoided.

The operation at the hip joint is the most formidable of all the amputations. In performing it, it is often essential to get the operation over as rapidly as possible, and this is the case especially when a tourniquet cannot be applied. The surgeon will require at least four assistants: one to administer the anæsthetic; a second to attend to the tourniquet, and if needful compress the artery in the groin; a third to support the limb; and a fourth to manipulate it so as to facilitate the movements of the knife. The tourniquet which is in use in this amputation is one invented by Sir J. Lister, and generally called after his name; but he has pointed out that Professor Pancoast, of Philadelphia, had previously designed a similar instrument.¹ It is a large horseshoe tourniquet, resting by a broad base on the loins, and somewhat steadied by a strap which passes from its expanded end to its arm. The end of the arm carries a screw and pad. The pad is applied over the aorta, just above the umbilicus, and by screwing it home (if the tourniquet is of the proper size) the pulse in both groins can be arrested, which shows that the aorta is commanded. This method of controlling the hæmorrhage is most efficient, and I have used it several times with perfect success. In a child who is not too stout the aorta can be easily commanded by manual pressure. But the pressure required to stop the pulse in the abdominal aorta in an adult, especially if the abdomen is stout, must be great, and sometimes produces alarming dyspnœa. Accordingly Sir J. Lister himself no longer recommends it. Many other plans are in use. Mr. Davy describes, in the '*Brit. Med. Journ.*' May 18, 1878, a plan for compressing the common iliac artery by means of a stick or wooden lever introduced into the rectum, so as to catch the artery against the spine between the bodies of the lumbar vertebræ and the psoas muscle—the lever being tolerably parallel to the opposite thigh. The rectum is filled with about an ounce of oil before the introduction of the lever, which itself is to be carefully planed in a turning lathe. This plan has now come into common use in amputation of the hip, and is usually perfectly successful. It has great advantages over the compression of the aorta, both in this operation and in many of those for aneurism. But it does not always

Amputation at the hip.

The aortic tourniquet.

¹ '*Syst. of Surg.*' 2nd ed. vol. v. p. 652.

succeed, especially when the surgeon has to carry the incisions unusually high ; and the lever has been known to lacerate the walls of the bowel. Mr. Jordan Lloyd¹ describes a method which seems to me very promising, and which I have seen very successfully applied. A common roller is laid lengthwise over the external iliac artery. A strip of india-rubber bandage about two yards long is doubled, and passed between the thighs, the centre of the doubled bandage lying midway between the anus and tuber ischii. The ends of the bandage are then drawn upwards and outwards, one in front and one behind, to a point above the centre of the crest of the ilium, and drawn tight enough to stop the pulsation at the groin. The pressure of

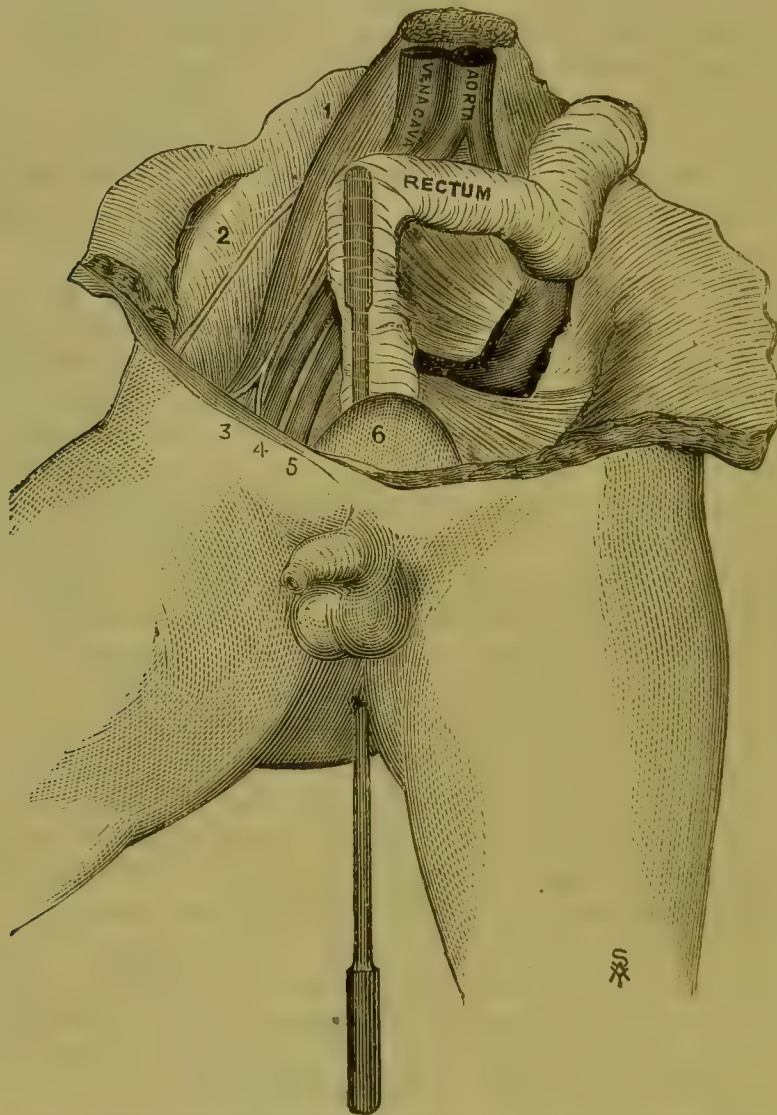


FIG. 415. Drawing showing the application of Davy's lever. 1, abdominal wall; 2, iliacus muscle; 3, psoas muscle; 4, external iliac artery; 5, external iliac vein; 6, bladder.

the back part of the bandage will control the branches of the internal iliac in the buttock. The ends of the bandage are held firmly by an assistant, with his hand placed just above the centre of the crest of the ilium, or if more firm pressure is needed, each end can be confided to a separate assistant. This apparatus is well out of the surgeon's way. The method which Sir J. Lister now recommends (see his Essay, p. 722) is essentially the same. When from any cause the compression fails, the assistant who is managing

¹ 'Lancet,' 1883, vol. i. p. 897; 'Contributions to Operative and Clinical Surgery,' 1883, p. 54.

the anterior flap makes pressure in the groin. Other assistants (or if there are only four, the fourth) will press sponges on the vessels in the posterior flap as they are cut.

The easiest and quickest way of amputating at the hip is by antero-posterior flaps. The knife is entered midway between the anterior superior spine and the great trochanter, and its point is brought out in the middle of the fold between the nates and perinæum, in doing which the operator, if he knows accurately the position of the joint, will probably open it. While this is being done the fourth assistant, who has gently flexed the limb in order to facilitate the opening of the joint, brings it quite straight, and the operator cuts out a long anterior flap, reaching about four or five inches from the groin if the tissues there are healthy. The second assistant draws this flap upwards, the operator cuts the joint freely open with the point of his knife, and the fourth assistant by strongly extending the thigh makes the bone start out of the socket. Then he

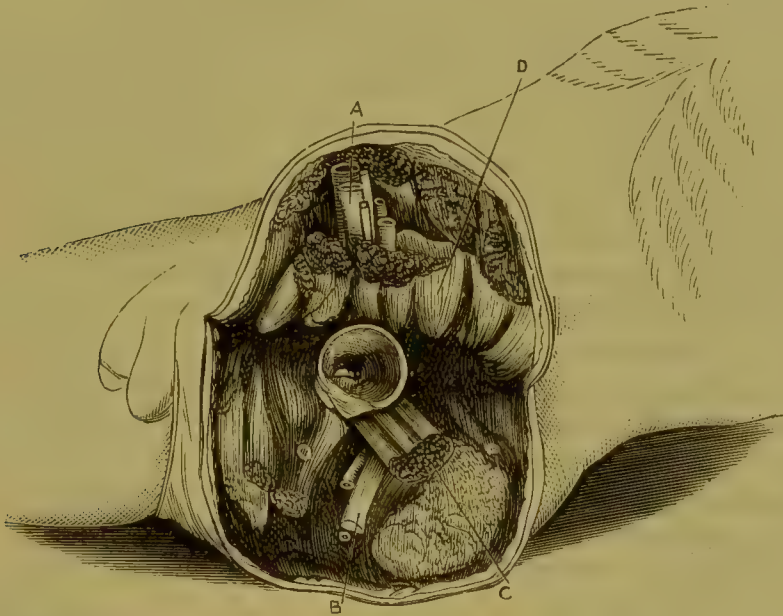


FIG. 416. Amputation at the hip by the long anterior and short posterior flap. A, the femoral and profunda vessels, with branches of the anterior crural nerve. B, the great sciatic nerve and its companion artery. A large branch of the sciatic artery is seen in front. C, the muscular mass from the tuber ischii and the obturator externus muscle. Large branches are seen on either side from the profunda and gluteal. D, the psoas and other muscles immediately in front of the joint. The knife must be passed beneath this mass of muscle in the first transfixion, so as to avoid all danger of puncturing the femoral artery.

flexes and adducts the limb so that the trochanter may become prominent, and the surgeon passes the heel of his knife round the trochanter, and gets its blade altogether behind the femur. As he does this, the fourth assistant, following his movements, brings the limb straight again, and the posterior flap is cut out. The third and fourth assistants are now free to attend to the vessels and help the operator in securing them. The long anterior flap has reached below the bifurcation of the femoral, and the first care of the surgeon is to tie the femoral and profunda arteries (Fig. 416, A). When this has been done the second assistant's hands are at liberty, and then the large vessels in the posterior flap should be secured, while any smaller bleeding arteries in the anterior are compressed. The continuation of the sciatic artery, and the comes nervi ischiadici will be found near the sciatic nerve, large branches from the internal and external circumflex on either side, and some branches probably from the gluteal. When all the vessels are tied there is an ample covering for the stump, the parts forming which are shown in Fig. 416. Mr.

Furneaux Jordan¹ has lately introduced a new method of amputation at the hip joint, which appears to me to supersede any that have been hitherto described, inasmuch as it is attended with far less loss of blood and diminished shock than any other operation, and also renders aseptic treatment of the wound easy, since it is far removed from the anus, and therefore there is ample space for an effectual antiseptic dressing. The longer time occupied by the operation is a matter of comparatively little moment now that we have the means of efficiently controlling the hæmorrhage, when the operation is performed by Furneaux Jordan's method, by the plan suggested by Mr. Jordan Lloyd. Furneaux Jordan's method of amputating at the hip joint consists in making an incision from the top of the great trochanter for about six inches down the outer side of the thigh; this incision is carried down to the bone, the hip joint is opened, and the head of the femur enucleated from the acetabulum and the soft parts rapidly separated from the bone. The thigh is finally removed by a circular sweep of all the structures down to the bone at the lower extremity of the longitudinal incision, thus leaving a long, boneless stump. The operation may also be advantageously modified by reversing the proceedings. A circular sweep of the thigh is first made through all the soft parts down to the bone, at the level of about six inches below the hip joint; the bone is sawn through at the same level, and all the vessels secured. A vertical incision is then made from the top of the trochanter, down the outer side of the stump to its extremity, and the remains of the bone enucleated from the joint and separated from its muscular attachments. In some cases the periosteum can be saved from the shaft of the femur, and in this way the attachments of the muscles can be preserved and a certain amount of new bone may be formed, which will very much alleviate the patient's after condition by permitting of the adaptation of an artificial limb, with which he will be able to get about. In a case exhibited by Mr. Shuter² at the Clinical Society, in which this operation had been performed and the upper end of the femur dissected out subperiosteally, the patient was able to wear an artificial limb and get about very satisfactorily.

Amputation of the thigh.

The thigh may be amputated in various ways, and at any level, the femur being divided as high as the trochanter, or as low as the condyle; but surgeons are always anxious to go as low as is consistent with removing the disease, remembering Dieffenbach's saying that 'the danger rises with every inch.' The old circular amputation, or a combination in which the skin is cut in flaps, the longer anteriorly, and then a circular sweep is made through the muscles, seem to me the best methods. For the amputation close on the knee joint Mr. Carden's method is now in great favour. Its principle is that of making the whole stump out of one long anterior flap of skin reaching below the patella, and cutting the posterior skin and muscles straight down to the bone; then raising all the soft parts somewhat from the bone and dividing it horizontally through

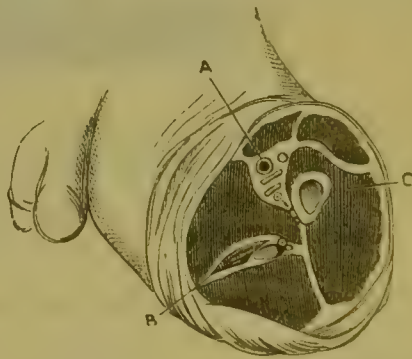


FIG. 417. Stump of circular amputation of thigh below the middle. The sleeve of skin has been quite turned back to show the flat face of the stump. A shows the femoral artery, its vein behind it, and the profunda vein and artery behind them. The sartorius covers the vessels. B shows the great sciatic nerve and its companion artery, the semi-membranosus muscle lying close to it and dividing the mass of adductors from the biceps and semi-tendinosus. C shows the triceps extensor with the rectus above it. Muscular arteries will have to be tied in all these masses, their number varying with the nature and duration of the disease.

¹ 'Surgical Inquiries,' 1880.

² 'Clin. Soc. Trans.' vol. xvi. p. 86.

the condyles, below the medullary canal. This is sufficient in most cases of disease of the knee, and leaves a very long and very useful stump. It is believed also to be less exposed to the danger of osteomyelitis than the operations are in which the medullary canal is laid open. Flap operations can also be performed in any part of the thigh, either by antero-posterior or lateral flaps. Mr. Teale's method by rectangular flaps is not applicable to the thigh, in consequence of the high level at which the bone must, on this method, be necessarily divided.

Amputation through the knee joint is a very useful operation in appropriate cases. Its main advantages are the length and power of the stump, and the broad unirritable surface for the application of the artificial limb. Its disadvantages are the tendency to sloughing, and to abscess extending up the thigh. The former objection applies especially to the operation by the long anterior flap, described in previous editions of this work. But this operation must now, I think, be abandoned in favour of either lateral flaps or a modified circular method. The operation is applicable chiefly to cases where the whole of the leg is destroyed by accident, or where a malignant or other tumour necessitates the removal of the leg, yet there is enough sound skin below the knee to cover the end of the femur. The operation by lateral flaps may be performed in several ways. There is the method of Pick, who commences his incision in the middle line at the upper border of the patella, and carries the knife down the middle line of the limb as far as the tubercle of the tibia, from which point it is carried laterally on each side to a point on the back of the joint corresponding to the commencement of the incision on the front. Thus two somewhat quadrilateral flaps with rounded corners are formed. The patella is then removed, the soft parts divided by a circular sweep of the knife, and the attachments of the tibia severed. The popliteal and one or two articular branches having been secured, a drainage-tube is inserted into the upper part of the synovial pouch (or perhaps better still through this pouch and the skin) and brought out of the wound, and the flaps are united. On convalescence the cicatrix will lie between the condyles out of the way of pressure. Dr. Stephen Smith's method is more complicated. He commences his incision about an inch below the tubercle of the tibia, and carries it downwards and forwards over the most prominent part of the side of the leg until it reaches the under surface, where it is curved towards the middle line, and thence carried upwards to the centre of the articulation. A similar flap is made on the other side, the inner being rather fuller than the outer to allow for the greater size of the internal condyle. Then the skin, fascia, and cellular tissue are dissected up, the ligamentum patellæ severed, and the tibia separated from the femur, the patella being left. Thus the end of the femur is covered with a large hood of soft parts. These will be drawn up the back of the limb, so that the cicatrix will lie partly between the condyles and partly at the back of the thigh. Another method, recommended by Mr. J. Hardie, of Manchester, is to draw the knife round the limb from the front of the leg, two and a half inches below the tubercle of the tibia, with a sweep inclining slightly upwards, and then dissect the parts up as in Stephen Smith's operation. Mr. Bryant dwells on the advantages of leaving the semilunar cartilages attached to the femur instead of removing them. The long anterior flap is cut by an incision convex downwards, starting from the back of either condyle, and reaching about five inches down the

Amputation through the knee joint.

leg; a posterior flap being formed either by transfixion, or by raising the skin and dividing the deep parts circularly.¹

Mr. Butcher describes an operation as 'amputation at the knee joint,' in which the end of the femur is cut through and the stump made chiefly from the skin and muscles of the calf, the latter being hollowed out as far as is necessary to render the flap pliable and admit of its being attached to the skin in front of the femur. This is, as it were, Carden's method reversed, and the latter is generally preferred.

Again, there is an operation which goes usually by the name of 'Gritti's amputation,' in which the flaps are formed as for the amputation through the knee joint, but, either in consequence of disease or injury in the lower end of the femur, or from not being able to get sufficient sound tissue to cover the condyles, the operator is obliged to saw through them. Then the patella is sawn perpendicularly, so that all its cartilage is removed. The anterior flap is brought over the sawn end of the femur, and the sawn surface of the patella applied to that of the femur.

Amputation of the leg may be performed by the circular method, which secures a somewhat lower section of the bones than any of the flap operations, or by skin-flaps and circular section of the muscles;² or by flaps formed on the anterior aspect by section from the skin inwards, and on the posterior by transfixing the parts and cutting outwards. In transfixing from the tibial side the operator must be careful not to pass his knife through the interosseous space in front of the fibula instead of behind it. I have seen this twice done on the living subject. Mr.

Teale's operation by rectangular flaps is, however, a very good method in this amputation, when the operator has no objection to dividing the bones somewhat higher up; and this seems a convenient place for describing it. No amputating-knife is required for this operation, which is performed with a rather large scalpel. Having made up his mind where he will divide the bones, the surgeon measures (with a tape or with his eye) the circumference of the limb; he takes a horizontal line the length of half this circumference with its extremities

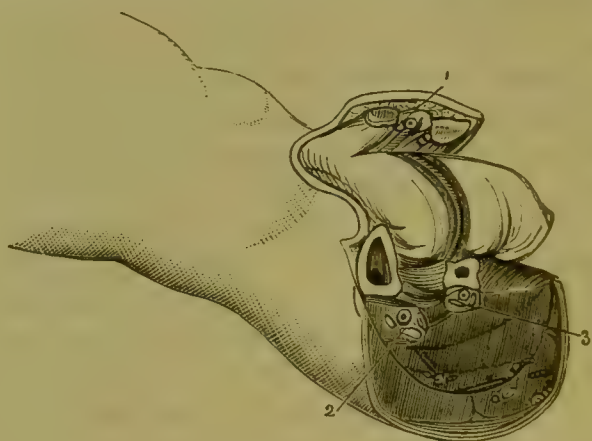


FIG. 418. Diagram of Teale's amputation of the leg, performed a little below the centre of the limb. The anterior long flap has been bent on itself, the better to show the position of the vessels. 1. The anterior tibial vessels and nerve. The artery is shown exposed throughout the whole length of the flap, where it has been peeled off the interosseous membrane. The tibialis anticus muscle is seen on its tibial side, the extensor proprius pollicis and extensor longus digitorum on its fibular side, external to which is the mass formed by the peroneal muscles, here perhaps rather exaggerated in size. 2. The posterior tibial vessels and nerve lying near to the interosseous membrane, but separated from it by the tibialis posticus muscle, and from the tibia by the flexor longus digitorum. 3. The peroneal vessels lying close to the fibula, in the substance of the flexor longus pollicis. In the cut face of the short and thick posterior flap are seen the section of the soleus, and superficial to this that of the gastrocnemius muscle, each containing the mouths of several muscular vessels.

¹ On the subject of amputation at and near the knee joint I would refer the reader to papers by Mr. Pollock and Sir W. Stokes in 'Med.-Chir. Trans.' vol. liii.; by Mr. Pick, in 'Med. Soc. Proc.' vol. vii.; Dr. Stephen Smith, 'Am. Journ. Med. Sc.' January 1870; and Mr. Bryant, 'Med.-Chir. Trans.' vol. lxi. p. 163, with the discussion reported in 'Med.-Chir. Proc.' New Series, vol. ii. p. 27.

² In this operation Mr. Bryant is strongly in favour of lateral flaps. 'Med.-Chir. Trans.' vol. lxi. p. 178.

Amputation of the leg.

Teale's amputation.

lying behind the tibia and fibula, and from the ends of this line he draws two incisions of the same length as the base vertically downwards,¹ and unites their ends by an incision parallel to the base. He cuts through all the tendons and vessels straight down to the bones and interosseous membrane, and then raises all the parts, including the anterior tibial vessels, from the bones and interosseous membrane. Much care must be taken not to notch the artery in doing this, the edge of the knife being kept always on the membrane. Having raised the anterior flap completely, the operator cuts the posterior flap by a transverse incision running across the back of the leg down to the bones, the posterior flap being a quarter the length of the anterior. The interosseous membrane being divided and the bones perfectly cleaned, the saw is applied. For this purpose the leg is turned outwards, so that the fibula is first presented to the operator, and the division of the fibula completed while the tibia is still only half sawn through. The vessels having been tied (see Fig. 418), the long anterior flap is bent over, its lower edge sewn to that of the posterior flap, and its doubled lateral edges stitched together. If the flaps have been cut truly, the whole fits perfectly, and when it unites kindly it makes a most excellent stump; but it is not a suitable operation for weakly persons, on account of the probability of sloughing of part of the long flap, and if secondary hæmorrhage comes on it is very troublesome.

Mr. H. Lee has proposed to reverse Teale's proceeding, making the long flap from behind instead of in front, so as to obtain thicker tissue for the long flap, which is therefore less liable to slough, and to avoid leaving a long piece of nerve (the anterior tibial), which has to be bent on itself in adjusting the flaps.² I have seen very good results from this operation in Mr. Lee's hands and my own; but it is somewhat difficult to be certain of the position of the posterior tibial vessels in performing it, and the tendinous part of the gastrocnemius muscle in the lower part of the leg does not easily lend itself to the bending which the long flap has to undergo.

Teale's method provides the bones with a thick cushion formed in great part of muscles. These muscles ultimately waste away, but while they are undergoing this process the stump becomes consolidated, and the skin does not adhere to the bones, so that the face of the stump will bear the wooden leg to press directly on it.

In performing amputation of the leg when the tissues are at all consolidated by inflammation, it is often difficult to retract the parts from the bones. In such cases a linen retractor is required. This is made with a long piece of stout linen, in one end of which a tongue is cut or torn, leaving this end to consist of three strips, the central one the narrowest. This tongue is passed through the interosseous space, the broader ends are crossed in front of the bones, and thus the parts can be forcibly pushed up and the bones exposed much higher than is otherwise possible.

In amputating the leg the posterior tibial artery often retracts into the corner of the stump (especially when the flaps are made by transfixion), and it is very troublesome to tie it, or any of its branches divided near the trunk.

Syme's amputation through the ankle joint is thus performed, if we follow the directions of its author:—The anterior flap is formed by drawing the knife from the point of the external malleolus to the corresponding point on

Syme's
amputation.

¹ As the limb rapidly decreases in size the lower end of the flap includes much more than half the circumference of the leg.

² 'Med.-Chir. Trans.' vol. xlviii. p. 195.

the opposite aspect of the foot, i.e. below and behind the internal malleolus. The anterior flap can be made to extend down the dorsum of the foot a short distance if the surgeon thinks fit. The posterior flap is made by drawing the knife from one end of the anterior flap to the other across the lower surface of the os calcis, inclining it rather towards the heel, so that the incision slopes backwards. The posterior flap is then dissected back and thrown round the end of the os calcis until the tendo Achillis is separated from that bone and the knife turns round the upper aspect of the calcaneum. In doing this the operator must be careful to keep the edge of the knife directed towards the bone, so as not to score the skin and not to make a button-hole. It is impossible to do this satisfactorily if (as is often directed) the flaps extend from one malleolus to the other; for this makes the inner part of the flap so high and broad that it can hardly be dissected round the heel without great force. When the os calcis is denuded, the anterior flap is to be thrown up, the ankle joint opened, the knife passed round the inner and then the outer malleolus, and the foot removed. Next the tibia and fibula are to be cleaned for about half an inch, taking care by keeping the knife close to the bone that the posterior tibial artery is not punctured, and a thin horizontal slice of the tibia with both malleoli sawn off. The arteries are then secured (Fig. 419), and the flaps sewn up. Many surgeons think it best to pass a drainage-tube from one angle of the wound through an opening made at the back near the tendo Achillis, so as to secure more efficient drainage.¹

The operation, however, is much more easily performed in the reverse manner to that described by Mr. Syme. The flaps are marked out, the anterior one formed, the joint opened, and then the posterior flap dissected from the upper part. In this way the difficulty of dissecting the posterior flap round the heel is quite avoided, and it is a matter of indifference to what exact points the incisions are drawn.

This amputation is now sometimes performed in the sub-periosteal manner, the periosteum of the os calcis being raised in the lower flap, and only the malleoli being removed from the bones of the leg. The object is to give a longer and more solid stump.²

The great recommendation of Syme's amputation is the excellence of the stump which it forms, the tissues of the heel being capable of sustaining any pressure, so that the patient walks about easily with a kind of elephant's foot apparatus, which can be made to resemble the natural foot to a great extent by having a foot-piece put on to it, and he can walk a short distance well enough without any apparatus at all. The operation is available in most cases of disease of the ankle and tarsus, and in many cases of injury.

¹ The reason why Mr. Syme was so emphatic in directing the operator to avoid making a 'button-hole' was not so much because the hole is in itself a disadvantage, as because it shows that the knife is directed towards the skin and is dividing its nutrient vessels.

² G. H. B. Macleod and Joseph Bell in 'Brit. Med. Journ.' vol. ii. 1875.

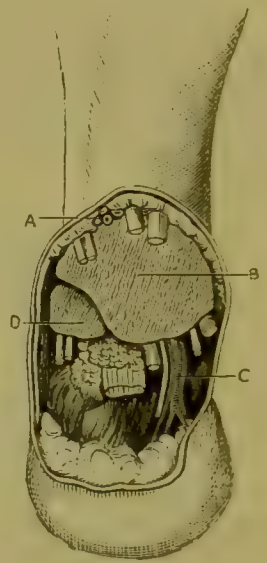


FIG. 419. The stump of Syme's amputation. A, the anterior tibial vessels and nerve, divided below the point where the extensor proprius pollicis passes over them. B, the section of the tibia. D, that of the fibula. C, the posterior tibial artery and its bifurcation. External to this is seen the tendon of the flexor proprius pollicis, and in the middle line the tendo Achillis.

Pirogoff's amputation is a modification of Syme's, in which the extremity of the os calcis is saved and is applied to the cut end of the tibia, in order that it may unite with that bone and form a longer stump. The flaps being marked out in the same way as in Syme's amputation, the saw is applied to the incision across the under surface of the os calcis, and that bone is sawn in a direction sloping upwards and backwards to its upper surface behind the ankle. Then the joint is opened, and the malleoli and under surface of the tibia removed just as in Syme's amputation. The section of the os calcis is then placed in apposition with that of the tibia, and the wound united. The movable flap is held in position by a broad strip of plaister, or the two bones may be drilled and sutured together. The leg is to be laid on its outer side, with the knee flexed, so as to take off the tension of the tendo Achillis. When all goes well Pirogoff's amputation forms a very good stump; but it is not very often available, for in cases of disease requiring amputation the os calcis is usually, or very often, involved, and in cases of injury either, on the one hand, more of the foot can be preserved, or, on the other, the surgeon finds himself obliged to amputate through the leg.

Pirogoff's
amputation.

In some cases it may be that the os calcis and the bones of the front of the tarsus are diseased or injured, but the astragalus is healthy; and then a very good stump may be made by forming a heel and a dorsal flap long

Subastragaloid amputation.

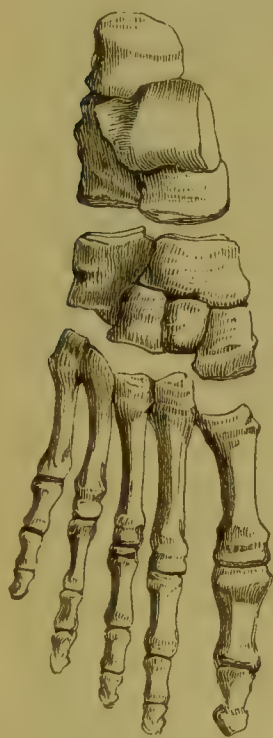


FIG. 420. Skeleton of the foot. Chopart's amputation is performed at the transverse tarsal joint, where the bones are separated from each other behind. Lisfranc's at the tarso-metatarsal articulations, where they are separated in front.

enough to meet beneath the astragalus, severing that bone from its connection to the calcaneum and scaphoid, and leaving it in the ankle, while the rest of the foot is removed, but I have not had any opportunity of seeing this operation practised. It does not seem of much importance by what precise incisions the flaps are formed, so that they are sufficiently ample, and that the lower flap is formed chiefly of the tissues of the heel, as in Syme's amputation. I must refer the reader for the details of the published cases of this rare operation to Mr. Hancock's 'Lectures on the Anatomy and Surgery of the Foot,' pp. 191 et seq., where he will find described also a modification of the subastragaloid amputation devised and performed by Mr. Hancock himself, and bearing the same relation to the ordinary subastragaloid amputation as Pirogoff's does to Syme's amputation. Mr. Hancock preserves a portion of the back of the os calcis in the heel-flap, saws off the head of the astragalus and its lower articulating surfaces, and then adapts the cut surface of the os calcis to that of the astragalus. The result, as figured in Mr. Hancock's work, is an excellent stump, almost as long as the sound limb, and quite capable of bearing any amount of pressure.

Hancock's
amputation.

The distinguishing recommendation of the subastragaloid amputation is the increased length of the stump, even as compared with Pirogoff's, and still more with Syme's amputation, and this advantage attaches still more strongly to Hancock's amputation.

Chopart's amputation is performed through the transverse tarsal joint (Fig. 420). The tuberosity of the scaphoid is easily felt, and the position

Chopart's
amputation.

of the calcaneo-cuboid joint halfway between the external malleolus and the point of the fifth metatarsal bone is known. An incision is drawn across from one of these points to the other with a scalpel, and a short dorsal flap is cut, the transverse tarsal joint opened, and the bones fairly separated from one another. Then by means of an amputating knife a long plantar flap is cut outwards, or towards the skin. This flap can, of course, be cut with the scalpel by incision from the skin almost equally readily.

One objection often made to Chopart's amputation is that the tendo Achillis is liable to displace the bones upwards, being no longer antagonised by the tendons in front, so that the scar is brought downwards and the stump becomes too irritable to bear the pressure. This defect is not always noticed, nor is it easy to see exactly on what its occasional absence depends. It may be avoided, according to some, by subcutaneous section of the tendo Achillis at the time of the operation, a complication which, however, it is desirable to avoid. The plan of passing the sutures through the tibial tendons, so as to attach them to the cicatrix (due, I believe, to the late Mr. Delagarde of Exeter) is worth bearing in mind.

Lisfranc's
or Hey's
amputa-
tion.

Lisfranc's operation consists in removing the whole metatarsus with the toes, and leaving the tarsus intact. Hey's amputation is the same, except that the second metatarsal bone is divided, and its head left in the articulation between the cuneiform bones; or the projection of the internal cuneiform bone is sawn through and removed along with the toes, after the other tarso-metatarsal joints have been divided with the knife. The projection of the second metatarsal bone backwards (Fig. 420) is the only difficulty in this operation. The position of the articulation of the great toe with the internal cuneiform, and of the little toe with the cuboid, being fixed, a curved incision is drawn from the one point to the other, and as much flap as possible taken from the dorsum. The flap being thrown back, the joint between the great toe and internal cuneiform bone is divided, then the point of the knife is carried directly backwards till it is stopped by the middle cuneiform bone, when it is directed outwards, and then forwards again, so as to cut entirely round the head of the second metatarsal. Then by pulling the metatarsus forcibly downwards, while the knife is passed along the line of the articulations, which slopes backward, the disarticulation is completed, and the plantar flap may be cut by transfixion or incision, as in Chopart's amputation. This operation is used almost exclusively in cases of injury, so that as much flap as possible must be taken on both sides to compensate for any possible sloughing.

Finally, amputation may be performed through the tarsus in any situation, by simply fashioning flaps and sawing through the bones; and this proceeding is, in the opinion of Mr. Hancock, the highest authority on these operations, superior to the amputations performed through the articulations.

The toes may be amputated exactly as the fingers are, but here it is still more undesirable than in the hand to remove the heads of any of the central metatarsal bones. If any of the smaller toes require removal the whole toe should be amputated, since the portion left would be useless, and might be in the way. The heads of the first and fifth metatarsal bones should always be cut off in amputating those toes, the incision through the bones being sloped off if possible. The great toe with the head of its metatarsal bone can be removed by a V-shaped incision; the point of the V lying over the middle of the metatarsal bone, in front and behind, and its limbs extending forward on either side of the ball of the toe, as far as is necessary to form

ample lateral flaps. If the whole metatarsal bone is to be removed, the point of the **V** must be extended backwards as far as the situation of the tarso-metatarsal articulation, and the toe having been removed the metatarsal bone is dissected out from the incision, care being taken, in dividing its head from the cuneiform bone, to keep the knife so close to the bone as not to wound the plantar arch.

EXCISIONS.

EXCISIONS of joints and bones are operations which are quite of modern date, and which, in fact, could hardly be practised freely before the invention of anæsthesia. They are performed chiefly on account of disease of the articular surfaces or of the tissue of the bone excised, sometimes (as in excision of the scapula and clavicle) on account of the growth of tumours from the bone, sometimes as primary or secondary operations after injury.

It is very difficult to compress into a short compass any rules for the performance of excision which shall be of practical utility and of general application. Perhaps the most practical view of the matter is to consider the operation of excision as opposed (1) to the preservation of the limb without any operation, or at least without anything more than the laying open of sinuses and removal of dead bone, and (2) to amputation.

General indications for excision.

1. Both in injury and disease the surgeon is much more disposed to adopt the conservative plan in the case of the hip and knee, and the operation of excision in that of the elbow; since the latter operation if completely successful gives a more serviceable limb than the natural cure. With this reservation it may generally be said that so long as the pain and exhaustion accompanying disease of the joint is not producing an obvious effect on the general health it is right to persevere in the attempt to save the limb without operation, and that in cases of injury much may be done in young subjects to preserve the limb, particularly after gunshot wound, by laying the joint fully open and removing splinters, the case being treated antiseptically: while excisions are extremely unsuccessful in such cases. Primary injuries of other kinds are rare, except in the elbow (where excision is usually advisable), but when they occur they are to be treated on the same principles. Finally, there are cases arising both from disease and injury in which there can be no doubt that the patient will recover with ankylosis of the limb; but the position or relations of the surfaces are such as to render it doubtful whether this will be a benefit to him. Cases of disease of the knee are not rarely seen in which the patient has rejected operation and has recovered, but with the bones so displaced and so insecurely ankylosed as to prove a source of lifelong trouble to him. A timely excision will often insure a useful limb.

Excision as contrasted with the conservation of the limb.

2. In the knee and ankle excision should hardly be proposed after about forty years of age, and only rarely after thirty.¹ In the elbow and shoulder the same limits do not so strictly apply, yet in all joints it is more satisfactory when the patient has passed middle life to have removed the disease once for all. In no case should any joint of the lower extremity nor the wrist be excised unless the surgeon has the clearest evidence that the disease is limited to the immediate neighbourhood of the joint. Much more liberty may be

Excision as contrasted with amputation.

¹ I have recently excised the knee in two cases at a time of life considerably beyond forty years of age, and in one of them with great success; but this can, I think, only be done successfully when the disease is in a very chronic condition, as in Mr. Gant's patient, *æt.* 53. — *Med.-Chir. Trans.* lvi. 213.

taken in the shoulder and elbow. I have excised the elbow with great ultimate success in a case where nearly the whole shaft of the radius was diseased, and it is well known what extensive excisions of the upper end of the humerus are sometimes successfully practised in cases of disease following gunshot injury. Excisions of the lower limb are hardly ever successful in acute stages of disease,¹ while in the elbow, at any rate, the operation, in such circumstances, is often productive of great and immediate relief. Tumours of joints are, as a rule, to which few exceptions will be found, only appropriate for amputation. General constitutional disease is, like old age, a strong argument for amputation when any operation is indicated.

In fine, excision is a more dangerous operation than amputation, and is liable to many sources of failure, and practice to be successful must be based on a recognition of this truth.

General
direction
for ex-
cisions

The operations resemble to a certain extent the dissections by which tumours are removed. The diseased joint or bone may be regarded as a tumour to be exposed by appropriate incisions, the soft parts turned aside without injuring the main vessels and nerves, all its connections severed, and the whole of the morbid tissue removed. But there is this further consideration in performing an operation of this kind, that the morbid structure removed is an important part of the skeleton, and that the operation must be so performed as to make provision for the subsequent stability or mobility of the limb as may be required. Thus, in the excision of the knee, it is important that the bones should be firmly ankylosed, a result which is especially to be deprecated in the elbow. The instruments required in excisions are, in addition to the usual dissecting instruments, saws of various sizes, from the amputating to the 'keyhole' saw, retractors, the lion-forceps, and the cutting bone-forceps. In subperiosteal excisions the operator must have various raspatories, i.e. semi-blunt chisels or rasps, as well as the chain-saw, and a combination of a raspatory and director for the purpose of detaching the periosteum from the bone and carrying the chain around it. For some excisions a combination of a staff and director is very useful—the 'excision director.' This is shaped like a lithotomy staff, and mounted on a jointed handle. Its convex side is grooved. It is glided under the bone to be removed—say the neck of the femur—and then by reversing its position its grooved surface is turned towards the bone and lifts it out of the wound, while its concave part lies over and protects the soft parts.

The use of Esmarch's bandage is, as I have said above, p. 945, very advantageous in most of these operations.

In late years the advantages of preserving the periosteum ('subperiosteal or subcapsulo-periosteal excision') have been much insisted on by Ollier and Langenbeck; and in some excisions they are incontestable, while in others the advantage of the new method is, at any rate, not as yet proved. I shall refer to the subject in speaking of each several excision.

Excision
of the
shoulder.

Excision of the shoulder is perhaps as successful as any, even that of the elbow, considered merely as an operation, and is equally applicable in cases of injury and disease; but it differs from excision of the elbow in the important particular that its results at their best are probably inferior—certainly not superior—to those of natural ankylosis, and therefore that it

¹ Perhaps the ankle is an exception. I have excised this joint with success though acutely inflamed.

should never be practised when there is any good prospect of obtaining a cure by natural ankylosis. As this cure is very often obtained in cases of disease of the shoulder, excision is but rarely practised in civil life. In gunshot injuries, when the missile has not penetrated beyond the bones of the joint, as in the cases figured on pp. 343, 344, it is a very successful operation. In tumour springing from the head of the bone it might be justifiable to excise the affected portion of bone if it could be clearly diagnosed that the tumour is not malignant, but this could very rarely be the case.

The operation, as usually practised, consists merely in removing the head of the humerus. This may be done, if there is not much thickening over the joint, by a single incision running downwards as far as may be judged necessary from the centre of the coraco-acromial ligament, over the most prominent part of the head, where it is most plainly felt beneath the skin. This line of incision corresponds pretty nearly to the direction of the long tendon of the biceps muscle. In some cases it is necessary to make a flap out of the deltoid muscle, of a somewhat triangular shape, with its base upwards. The precise position of the incisions which bound this flap is a matter of secondary importance, and is usually determined by that of the sinuses or wounds. The head of the bone having thus been exposed, is to be rotated (when the shaft is entire) first outwards, in order to stretch the tendon of the subscapularis, then inwards to make tense those attached to the greater tuberosity; these tendons are to be divided, and the capsule thus freely opened, and then the head of the bone is to be thrust out of the wound and sawn off. If the case is one of injury, and the head of the bone is severed from the shaft, it must be seized with the lion-forceps and dissected out. If the long tendon of the biceps can be distinguished it should be spared. In both disease and injury the glenoid cavity often escapes; but if it should be found affected, it may be thought necessary to remove it. This is best done with a large chisel or with bone-nippers of appropriate shape. The parts should be lightly put together by means of a few sutures, and the patient confined to bed for the first few days, until the consecutive fever has passed over. He may then be allowed to move about, the elbow being carefully supported. The tendency of the muscles which form the flaps of the axilla to displace the bone may be counteracted by a pad in the armpit.

The subperiosteal method should undoubtedly be adopted if the surgeon finds himself obliged to remove a great extent of bone. M. Ollier¹ directs that the incision should be made as far forwards as possible without wounding the cephalic vein, in order to retain the greater part of the deltoid muscle in its natural connection with the circumflex nerve, by which he hopes to preserve the action of that muscle. The joint is then to be cut into, and then all the tendons and periosteum peeled off the bones with raspatories of the proper shape, the humerus being gradually pushed out of the wound till the proper level is reached for its section.

Subperiosteal method.

I have never seen a case in which, after this excision, the arm could be elevated above a horizontal line,² and this seems to me to depend more on the loss of the joint, and the consequent want of a point of support for the humerus, than on any supposed loss of function of the deltoid. In fact, I believe that the atrophy of the deltoid is secondary on the loss of its function,

¹ 'Traité des Régénérations des Os,' vol. ii.

² Mr. Stokes, in an interesting paper on excision of the shoulder, published in the 'Brit. Med. Journ.' Nov. 10, 1883, relates and figures a case in which it seems that the arm could be raised slightly above the horizontal.

and that if the machinery for raising the arm could be reproduced—that is to say, if the head of the humerus could be regenerated along with a perfect capsule, so that the ball could be firmly applied to its socket as in the natural condition—the deltoid would soon regain its bulk and power. But there is no proof given by M. Ollier's cases that this is ever done; and the mere ligamentous union which generally ensues furnishes no such fulcrum. At the same time, the shorter the ligament the more power of motion will there be in the humerus; and to this end it is very important to preserve the periosteum if the bone is to be divided much below the tuberosities. Many histories show the extensive excisions which may be practised on the humerus with preservation of a very useful arm. One published in the 'Lancet' for July 18, 1874, by Dr. Donovan, records a case in which the whole bone from the head to a point just above the condyles was excised subperiosteally, in a case of acute periostitis in a boy, with good results.

Excision
of the
scapula.

The excision of the scapula on account of a tumour is a formidable operation, the advantages of which should be maturely weighed before its dangers are encountered. Operations on this bone for necrosis are much more likely to be permanently successful, but they rather resemble the common operations for extraction of a sequestrum than formal excisions.

The total excision of the scapula for a tumour should be thus performed. The patient being anæsthetised, an assistant should be charged with the compression of the subclavian artery, for which purpose, if the projection of the tumour makes compression difficult, the incisions may be so arranged as to enable him to put his finger directly down upon it. This precaution much diminishes the hæmorrhage from the subscapular artery and its branches, which otherwise might be formidable. The surgeon then proceeds to denude the tumour of its outer coverings by turning down appropriate skin-flaps, taking great care, however, not to open the capsule of the tumour itself.¹ When the whole tumour is thus exposed the muscles inserted into the vertebral border of the bone should be rapidly divided, as also those which are attached to the spine of the scapula. The tumour being now movable should be lifted well up, and freed from its other attachments by rapid strokes of the knife, commencing from its *lower* angle. The subscapular artery is divided near the end of the operation, and can be at once secured by the surgeon or his assistant, with a pair of Spencer Wells's artery clips. The ligaments of the shoulder are then easily divided and the mass removed. The acromion process, if not diseased, may be divided with bone-nippers, and left behind to preserve the shape of the parts and protect the head of the humerus.

Excision
of the
clavicle.

Excisions of any part of the clavicle should be undertaken with the greatest care on account of the close relations which the bone has to important structures, and on account of the risk of diffuse inflammation below the deep fascia of the neck; and the total extirpation of the bone for a tumour springing from its substance is one of the gravest operations in surgery. In Mott's case the operation lasted *four hours*, and thirty vessels were tied. Mott says, 'This operation far surpassed, in tediousness, difficulty, and danger, anything which I have ever witnessed or performed.' If it be decided to remove the whole clavicle along with a tumour, the incisions should be made very free, one over the long axis of the bone, joined by others in appropriate places for turning down such flaps as may

¹ See Pollock, in 'St. George's Hospital Reports,' vol. iv. p. 237.

appear necessary, and the parts to be operated on should be brought fairly into view before the bone is meddled with. After having freely divided all the superficial attachments of the bone and tumour, the next step is to divide the outer end of the clavicle from the scapula, either by cutting through the joint or by severing the bone with a small saw or nippers. Then the part which is to be removed can be raised, and must be separated with great care from the important parts which lie below it, so as to reach the sternal part, which is last divided, and which serves during the operation as a pivot on which the bone can be moved and supported; or, in other cases, it may be found more convenient to divide this part of the bone also at an earlier period of the operation.¹ It appears that very useful motion may be recovered after the removal of a large part, or even the whole, of the shaft of the clavicle.

Excision of the elbow is a most useful and a most successful operation. It is practised on account of injury and of disease with equal relative success, though the absolute success is, as in all operations, much greater in cases of disease than those of injury. Any disease which does not extend far from the articulating surfaces, and which is otherwise incurable, is a clear indication for excision. As caries of the joint-ends of the elbow hardly ever involves any extensive inflammation of the shafts of the bones, this comprises most cases of serious disease of this joint. There are even cases in which the disease is not incurable, but where the cure would involve long disuse of the limb and ultimate loss of motion from ankylosis, where it may be justifiable to resort to excision, if the patient be young and healthy, in the hope of cutting short the disease and procuring a more movable limb. And other cases are also met with, though rarely, in which the limb has been allowed to become ankylosed in an extended or otherwise useless position, and where the surgeon may be justified in excising the joint at the request of his patient after the risks and the probable advantages of the operation have been explained to him.

Excision
of the
elbow.

It must always be borne in mind in this operation that the object is to procure such union as shall be sufficiently firm to afford a fixed centre of motion for the bones of the forearm, and thus give precision and strength to the movements of the hand, and yet shall not be so close as to abolish any of the motions of the joint. In the most successful cases these indications are perfectly fulfilled, so that the motions of the hand are as extensive as on the sound side, and no case of excision of the elbow is to be reckoned as perfectly successful in which this freedom of motion has not been obtained. Such perfect success is more probable in childhood than in mature life, though even then it is often obtained, and if it be not, an amount of motion ought at any rate to be insured which leaves the patient a very useful arm even in cases which do not quite come up to the ideal.

The operation is now almost always performed by means of a single straight incision running parallel to the course of the ulnar nerve, but a little external to it—i.e. over the inner side of the olecranon and for about two inches above and below it. This incision is made fairly down to the bone, dividing the triceps muscle and the periosteum. The operator proceeds differently in the common and in the subperiosteal operation. In the ordinary operation he opens the joint freely by cutting round the olecranon,

¹ See Travers, 'Med.-Chir. Trans.' vol. xxi.

separates the muscles attached to the external condyle, divides the external lateral ligament, and dissects the parts off the humerus between the olecranon and internal condyle with much care, keeping the edge of the knife constantly on the bone, and pressing the parts away from the bone with the left thumb-nail cautiously so as not to endanger the ulnar nerve which lies amongst these parts.¹ Then the internal lateral ligament is divided and the lower end of the humerus cleared of any remaining attachments. If the end of the humerus can be thrust out of the wound without interfering with the bones of the forearm it is to be sawn across just above the condyles, or the olecranon may be cut away for this purpose before the rest of the disease is removed from the forearm. Then the bones of the forearm are to be thrust out of the wound and sawn off on the same level—i.e. just below the articular surface on the coronoid process, the head and neck, but not the bicipital tubercle of the radius being removed. It is far better to remove both bones together by a clean cut with a saw than to divide the neck of the radius with bone-nippers. And it is often convenient to reverse the usual order, by removing the bones of the forearm before dealing with the humerus. When the surgeon is satisfied that all the disease is removed, the bandage is relaxed (if, as is generally advisable, Esmarch's bandage has been employed), and the vessels tied with catgut ligatures. Then a few minutes are to be given for exposure and cold bathing to stay any residual oozing, the wound is to be united with silver sutures, a drainage-tube being inserted into it, and the arm put on a splint and dressed.

If the operator decide to proceed subperiosteally he must first take care that his incision has really divided the whole periosteum down to the bony structure, then by working with the raspatory on the back of the olecranon he will find it very easy to detach the periosteum there, and he must use all possible care to clean the back of the humerus completely of all soft structure—periosteum, capsule of joint, and tendons—and especially to detach as completely, and with as little injury as possible to their structure, all the tendons and other soft parts which adhere to both condyles. The end of the olecranon may now be removed in order to obtain access to the front of the ulna, detach the tendon from the coronoid process, and thus complete the denudation of the portion of the ulna which is to be sawn off. If the attachments of the orbicular ligament can be recognised and preserved it may be possible to remove the head of the radius without interfering with them. Now comes the most difficult part of the operation—viz. how to clean the front of the humerus of its periosteum. M. Ollier attempts this by gliding a curved instrument between the bone and periosteum and conveying a chain saw in its course; but this curved raspatory is very apt, when acting in the dark, to pass through the periosteum. It seems better to divide the bone with the keyhole saw from behind incompletely, and then fracture it, as is done by some operators while removing the end of the femur in excising the knee. The periosteum will remain untorn, and the surgeon can then proceed to detach it from either side, commencing from the part exposed in the wound. The advantages of the subperiosteal excision of the elbow, which is far more laborious and involves more violence to the tissues than the common operation, are, I must say, as yet unproved.

¹ The ulnar nerve is seen in operations on the dead subject, but in disease it is seldom visible, being hidden by the inflammatory products around the diseased joint. I have seen it in primary excision for injury in the living, and in excisions in which Esmarch's bandage is used it may sometimes be seen.

After the operation the limb should be placed lightly on a splint. The precise form of splint is of no importance; in fact, the splint itself is not absolutely necessary, for some surgeons of much experience use only a bandage. But I think the support and confidence which the splint gives are a great comfort to the patient, especially if startings of the limb take place, as they are rather apt to do. In about a week, when the parts are beginning to consolidate, the splint should be so arranged as to permit the hand to reach the mouth, and when the wound has nearly healed passive motion and then active motion is to be enforced. The precise time at which active motion is to begin cannot be fixed. If the quantity of bone prescribed above has been removed, there will very likely never be occasion for any passive motion at



FIG. 421. The method of slinging the limb after excision of the elbow.

all, and in no case ought it to be used until all active inflammation has passed over and the wound is almost healed. While the patient is in bed it is a comfort to sling the arm from a pole over the bed, as shown in Fig. 421.

The repair after excision is in rare cases by bony ankylosis. This is undoubtedly to be reckoned as a failure, and ought hardly ever to occur. It depends generally on the removal of too little bone, and on the neglect of passive motion afterwards. Commonly the repair is by means of fibrous bands which tie the ends of the different bones to each other. In rare cases there is considerable reproduction of bone and a complete joint is formed. This was the case in a remarkable instance described and figured by Mr. Syme, in which a considerable reproduction of bone had taken place from

Repair
after
excision
of the
elbow.

either side of the end of the humerus, and these two newly produced condyles locked in the two bones of the forearm, forming a complete hinge joint in which the radius played in a newly formed orbicular ligament. The patient, who was a railway guard, had been able to use the excised elbow as well as the sound one for the purpose of swinging himself from one carriage to another of the train in motion. This reproduction is quite as perfect as any which has been proved to take place after subperiosteal resection. In fact, the reproduced bone after the latter operation is often exuberant, and is detrimental to the motion of the joint.¹

The danger to life of excision of the elbow is trifling, especially when performed for disease. Of thirty-one successive excisions of the elbow for disease recorded in the St. George's Hospital Reports, performed at all ages from three to thirty-seven (six only being below fifteen years) and in very various states of health, none died, and only one, at most, suffered amputation. ('Syst. of Surg.' 3rd ed. vol. iii. p. 748.)

Excision of
the wrist.

Excision of the wrist as a formal operation is not often practised, since in cases of disease which are sufficiently serious to justify so very severe a proceeding the affection has generally extended too far; while in slighter cases the surgeon thinks that the patient will ultimately do better if only the diseased portions of bone be dealt with from time to time as may be necessary, and passive motion be kept up sedulously. In cases of injury I have never as yet heard of excision being practised.

The two chief objects in the operation of excision of the wrist are not to divide any tendons which can be spared, and to remove the whole joint, i.e. the ends of the bones of the forearm, all the bones of the carpus (except perhaps the pisiform), and the ends of all the metacarpal bones. This is best done according to Sir J. Lister's method, which is thus effected. The patient is placed under anæsthesia, and then the bandage or tourniquet being securely adapted, an incision is made commencing in front over the second metacarpal bone internal to the tendon of the extensor secundi internodii pollicis, and running along the back of the carpus, internal to the same tendon, as high as to the base of the styloid process of the radius. The soft parts, including the extensor secundi internodii and the radial artery, being



FIG. 422. Mr. Syme's case of reproduction of the joint after excision of the elbow. From the 'Lancet,' vol. i. 1855. *a*, the humerus; *b*, the ulna; *c*, the radius; *d*, *e*, projections from the shaft of the humerus locking in the bones of the forearm in the new joint; *f*, new orbicular ligament around the head of the radius; *g*, a portion of the ligamentous union between the ulna and humerus; *h*, tendon of the biceps; *i*, *k*, new lateral ligaments attached below to the end of the ulna on the one side, and to the orbicular ligament on the other.

¹ A very interesting account of the dissection of a case four years after subperiosteal resection will be found in Langenbeck's 'Archiv,' vol. x., by Dr. Doutrelepon, and another, still more interesting and complete, by Dr. Cheever in the 2nd series of 'Med. and Surg. Reports' of the Boston (U.S.) City Hospital. Both are illustrated by drawings of the reproduced articulations. I would refer to my essay in the 'Syst. of Surg.' 3rd ed. vol. iii. p. 744, for a discussion of the alleged advantages of the subperiosteal operation.

cautiously detached from the bones external to this incision, and the tendons of the radial extensors of the wrist being also severed from their attachments, the external bones of the carpus will be exposed. When this has been done sufficiently, the next step is to sever the trapezium from the other bones with cutting pliers, in order to facilitate the removal of the latter, which should be done as freely as is found convenient. The operator now turns to the ulnar side of the incision and cleans the carpal and metacarpal bones as much as can be done easily. The ulnar incision is now made. It should be very free, extending from about two inches above the styloid process down to the middle of the fifth metacarpal bone, and lying near the anterior edge of the ulna.

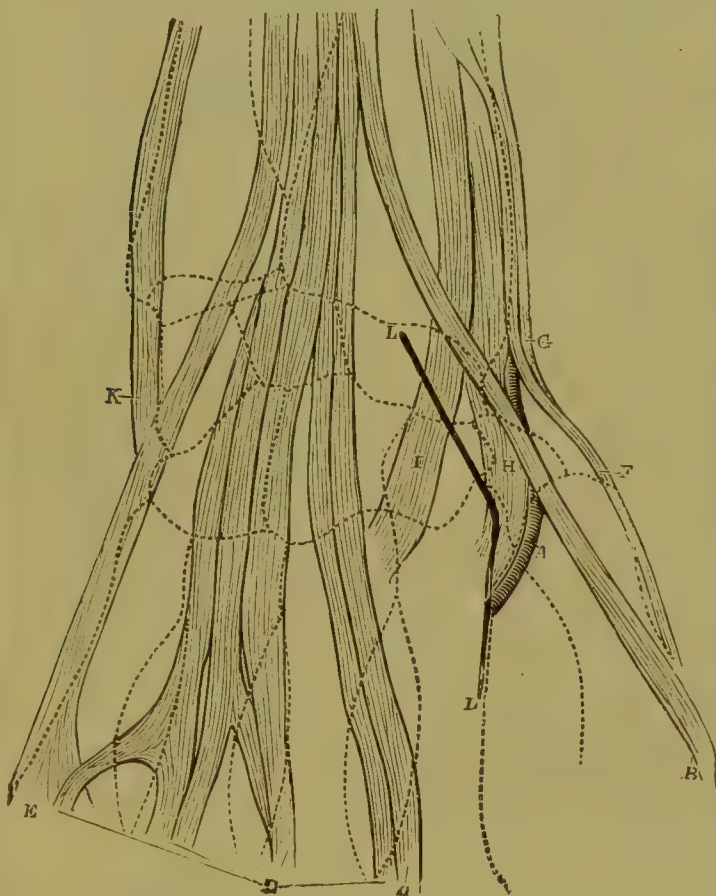


FIG. 423. Diagram of excision of the wrist. (After Lister.) A, the radial artery. B, tendon of the extensor secundi intermodii pollicis. C, indicator. D, ext. comm. digitorum. E, ext. min. dig. F, ext. prim. int. pol. G, ext. oss. met. pol. H, I, ext. carp. rad. long. and brev. K, ext. carp. uln. L L, line of radial incision.—From the 'Syst. of Surg.'

The dorsal line of this incision is then raised along with the tendon of the extensor carpi ulnaris, which should not be isolated from the skin, and should be cut as near its insertion as possible. Then the common extensor tendons should be raised, and the whole of the posterior aspect of the carpus denuded, until the two wounds communicate quite freely together; but the radius is not as yet cleaned. The next step is to clean the anterior aspect of the ulna and carpus, in doing which the pisiform bone and the hooked process of the unciform are severed from the rest of the carpus, the former with the knife, the latter with the cutting pliers. In

cleaning the anterior aspect of the carpus care must be taken not to go so far forwards as to endanger the deep palmar arch. Now, the ligaments of the internal carpal bones being sufficiently divided, they are to be removed with blunt bone-forceps. Next, the end of the ulna is made to protrude from the incision and is sawn off, as low down as is consistent with its condition, but in any case above its radial articulation. The end of the radius is then cleaned sufficiently to allow of its being protruded and removed. If this can be done without disturbing the tendons from their grooves, it is far better. If the level of the section is below the upper part of the cartilaginous facet for the ulna, the remainder of the cartilage must be cut away with the pliers. The operator next attends to the metacarpal bones, which are pushed out from one or the other incision and cut off with the pliers, so as to remove the whole of their cartilage-covered por-

tions. The trapezium bone, which was left in the early stage of the operation, is now carefully dissected out, so as to avoid any injury to the tendon of the flexor carpi radialis or to the radial artery, and the articular surface of the first metacarpal bone is then exposed and removed. Lastly, the cartilaginous portion of the pisiform bone is taken away; but the non-articular part is left behind unless it is diseased, in which case it should be removed entire. The same remark applies to the hooked process of the unciform.

The operation is one of the most tedious and difficult in surgery, but it appears to me to give very satisfactory results, and therefore should, I think, always be adopted in such cases as are favourable for any operation at all. It is advisable, if not necessary, to put on the tourniquet, or Esmarch's bandage, so that the view of the parts should not be obscured by blood. It is also very desirable to break down freely any adhesions which the tendons may have formed, while the patient is under anæsthesia previous to the operation.

No tendons are divided in this operation except the extensors of the wrist, for the flexor carpi radialis is inserted lower down than the point at which the metacarpal bone is divided.

In order to insure motion, particularly in the fingers, passive movements should be performed from a very early period after the operation. For this purpose, Sir J. Lister places the limb on a splint with the palm of the hand raised by a large wedge of cork, fixed below it; so that the joints of the fingers can be moved without taking the limb off the apparatus. Special arrangements are made for keeping the splint steady and for preventing displacement of the hand to either side. Careful and methodical passive motion should be used to each several joint—to those of the fingers and thumb almost from the day of operation, and to the wrist as soon as the parts have acquired some firmness, each movement, pronation and supination, flexion and extension, abduction and adduction, being separately exercised; and the patient should be encouraged to make attempts at voluntary motion as early as possible. In order to exercise the fingers, the portion of the splint which supports them may be removed, while that on which the wrist is received is still left. Finally, when the rigid splint is left off, some flexible support is still to be worn for a long time.

Excision of
the hip.

Excision of the hip is performed almost exclusively on account of strumous disease (so called) of the joint. The few cases in which this operation has been practised for gunshot injuries have, I believe, all occurred in military practice, and they have been exceedingly fatal.¹

I have spoken in the appropriate place (p. 501) of the indications for performing this operation in morbus coxarius, and have now only to deal with the operative details. Some operators content themselves with removing only so much of the femur as is diseased; others (as Dr. Sayre of New York) consider it necessary to remove the whole of the trochanter major. The latter plan seems to me to involve an unnecessarily extensive removal of bone; but if it is preferred I have no doubt that the subperiosteal method should

¹ Prof. Volkmann, in a lecture translated for the 'New Syd. Soc.' (German Clinical Lectures, p. 404), says that the experience of gunshot injuries of the hip joint accumulated in the American Civil War, and in the Prusso-Austrian and Franco-German wars, shows that nearly all such cases prove fatal, however treated, and that, although it is quite exceptional for a patient to recover after excision, yet the results of a purely conservative treatment have hitherto been no better—even slightly worse. See Longmore in 'Syst. of Surg.' 3rd ed. vol. i. pp. 559-560.

be followed, as recommended by Dr. Sayre. The ordinary operation is thus performed. A free incision is made, of a semilunar shape with the convexity backwards, over the posterior part of the trochanter, which should go boldly down to the bone. Then by cutting along the neck of the femur the joint is reached,¹ and it should be freely opened; the head of the bone twisted out of the joint, and the neck divided, with a keyhole saw, as low down as the surgeon thinks necessary. If the operation is performed for injury, and the neck of the bone is fractured, the incisions must be more extensive, the fractured part must be freely exposed, seized with the lion-forceps and dissected out, and then search must be made for bullets, fragments of bone, and other foreign bodies. Finally, the surgeon must carefully examine the acetabulum and remove by the gouge, trephine, chisel, and forceps all portions of diseased bone. In the subperiosteal resection the periosteum is divided just below the great trochanter, and that process is denuded from all fibrous tissue (periosteum and tendons) inserted into it, and this proceeding is carried on upwards till the joint has been laid freely open. Then the common tendon of the psoas and iliacus is divided with a knife, and the deep portions of the neck of the bone separated from the fibrous structures as well as it is possible. Mr. R. W. Parker, following Hueter, strongly advocates an operation performed by an anterior incision. A knife is entered half an inch below and external to the anterior superior spinous process of the ilium, and carried downwards and slightly inwards for the extent of three inches. The incision passes between the tensor vaginæ femoris and lesser glutei on the outer side, and the sartorius and rectus muscles on the inner side, and the front of the joint exposed. The capsule is now to be freely opened, and the neck of the bone cut through with a narrow saw or Gowan's osteotome. The head of the bone can then be severed from any remaining attachments and removed with sequester forceps. The cavity of the acetabulum is to be freely scraped out, and the exposed surfaces mopped out with solution of chloride of zinc (gr. 40 to ʒj.), then dried and dusted with iodoform. The drainage-tube is brought out at the lower angle of the wound. No splint is required; the limb should be simply supported by sand-bags, and, if judged requisite, extension may be made by means of a weight and pulley. The great advantage of this operation is that no muscle is divided, and the relative position of parts very little interfered with. The drainage from the lower part of the wound appears to prove efficient, but some surgeons are in the habit of making a small incision through the structures at the back of the joint and carrying the drainage tube through this.

Subperiosteal method.

It is usual in Europe to dress the wound lightly, and either put up the limb in a bracketed splint, or in a plaster of Paris case, or—which I have found easier and quite as satisfactory—with a weight and pulley. None of these plans aim at restoring the length of the limb. Dr. Sayre's plan consists in screwing the limb down by means of an extending apparatus to the same length as the other, and he asserts that in some cases, after removing a great length of bone, the limb has regained its normal length and all its natural movements.

The operation is a dangerous one—at least a great many patients die after

¹ Though the joint in advanced stages of disease is usually spoken of as 'dislocated,' it really hardly ever is so. Having excised the hip joint more than thirty times I cannot remember to have come across a case in which the head of the bone (or its remains) was not in the acetabulum, and Dr. Sayre says that in fifty-two cases of excision he has only found one of dislocation.

it; many, it is true, not from the operation, but from previous disease. Still, the number who have died from the direct sequelæ of the operation has not been small in my experience. Nearly half of the published cases seem to have proved fatal from one cause or other.

The limb is often an extremely useful one; but I think it is true that the natural cure by ankylosis leaves a limb which, though perhaps more deformed, is as a rule firmer and stronger than that left by excision. On this subject, and on the relative prospects of cure by the expectant and the operative treatment, much light has been thrown by the report of a committee of the Clinical Society, to which I would refer, in the fourteenth volume of their Transactions.

Union is almost always by ligament: ¹ in some rare cases, chiefly those which have been neglected, osseous ankylosis has taken place; in others no union has occurred, or the femur has been so loosely connected to the pelvis that the limb is useless.

Excision of
the knee.

Excision of the knee is an operation which has afforded excellent results in the less severe cases of disease of the synovial membrane and articular surfaces of that joint, for which amputation used to be performed. By 'the less severe cases' I mean such as occur in young persons of a tolerably healthy constitution, from chronic action, not spreading to any great extent into the bone, and not accompanied with very great distortion or atrophy of the limb. It is quite true that in many of these cases, if no operation be performed, the abscesses will dry up and the diseased bone exfoliate ultimately; but it is also true that this action often takes many years to accomplish, during the whole of which time the patient is unfit for any active employment, and that often at the end of it the limb is more an encumbrance than anything else, and frequently requires amputation. However this may be, it is certain that we used some years ago to see amputation practised in many of the same class of cases as are now treated most successfully by excision, and so far excision of the knee has been a great gain. But the attempt to show that it is in itself a safer and more successful operation than amputation has failed, and all judicious surgeons now agree that excision cannot be successfully performed above the middle period of life (say about forty, varying, however, of course with the constitution), or in phthisical patients, or in acute or extensive disease, or for tumours, in all which conditions amputation though dangerous is often successful.

Excision is also very dangerous when performed as a primary operation for injury, and especially those complicated injuries which follow on gunshot wounds; so that in these amputation is usually preferred, unless under exceptional circumstances—that is to say, in persons of remarkably sound constitution, or at early periods of life, and in whom the injury can be ascertained to be strictly limited to the immediate neighbourhood of the articulation.

The operation may be performed in several different ways. The one most frequently adopted is to make an incision from the back part of one condyle to the back of the other, passing across the front of the limb below the patella and slightly convex downwards. Others, again, make a horseshoe incision, with the convexity downwards, commencing at the side of one condyle of the femur, and passing immediately above the tubercle of the tibia to a corresponding point on the opposite condyle. A third plan, which is now very generally adopted, is to make a transverse incision across the front of the

¹ 'Syst. of Surg.' 3rd. ed. vol. iii. p. 757.

joint, over the middle of the patella, and saw through this bone, subsequently suturing it. This method, as well as that by a vertical incision recommended by Ollier and H. Allingham, necessitates leaving the patella, which is not always desirable.¹ The old plan, by the **H**-shaped incision, which used always to be employed in this operation, is now practically abandoned, unless there is much thickening about the soft parts, requiring their freer division. Whichever plan is adopted, the joint is to be freely opened by cutting at the sides of the condyles, so as to sever completely both lateral ligaments; and then the knife is to be carried round the posterior surface of the end of the femur, care being taken in doing this to thrust the femur out of the wound as much as possible, by an assistant forcibly flexing



FIG. 424. A section made through the femur and tibia in a child, aged five years, to show the position of the epiphysal lines and the point at which the section ought to be made in excision. If the section be made above the trochlear surface of the femur, the whole epiphysis will be removed. In the tibia, the whole articular surface may be removed without risk.—From the 'Syst. of Surg.'



FIG. 425. The same femur, shown in an anterior view to mark the level at which the saw ought to be applied.

the limb, and to keep the edge of the knife directed towards the bone, and guided by the finger, so as to avoid the popliteal artery, which here is

¹ It is my invariable rule to remove the patella, and this is, I believe, the usual practice. I can see no use in the bone if left, and much risk of recurrence of disease. (See also Swain, 'On Excision of the Knee Joint,' p. 73.) Dr. Patrick Heron Watson, on the other hand, counsels its preservation, when possible, for the following reasons: '(1) That its removal is unnecessary in most cases; (2) that its presence in the flap bears up the soft parts from the line of incision, and, without preventing consolidation, helps to keep them away from the cut margin of either osseous surface; (3) that its removal occasions more bleeding; and (4) that the hollow left after its removal from the centre of the long

separated from the bone only by some fat and loose tissue; and in sawing the bone it may be advisable, if the femur have not been very completely cleaned, not to pass the saw entirely through the osseous tissue, but rather to break than to cut the outer lamella at the back, by using the saw as a lever. The level at which the femur is to be divided should be carefully borne in mind in operating on children. I have repeatedly seen the surgeon take away the whole epiphysis and a part of the shaft from mere want of care, having forgotten, or omitted to ascertain, whereabouts this line is situated. Figs. 424, 425, show its true position, and will prove that in any case of excision in which the whole cartilaginous surface of the femur is removed, the shaft will be trephined upon. The end of the femur having been removed, the head of the tibia is to be cleaned and sawn horizontally, care being taken in young persons to keep close below the cartilaginous surface, so that the epiphysial line be not interfered with. In cases where there has been no dislocation, nor much alteration in the shape of the bones from previous disease, there is now usually no impediment to placing the limb in a straight position, with the bones in accurate adjustment. Otherwise they must be adjusted by taking off successive pieces from the end of the femur or tibia (if possible without going beyond the epiphysis); and in cases of old dislocation it is often necessary to sever some of the hamstring tendons. The parts should, in all cases, be adjusted in perfect position upon a splint, and the bandages firmly applied, before the patient is moved or allowed to recover from the anæsthetic.

If the femur appears at all prominent, a short splint should be applied in front, in order to counteract the tendency of the leg to gravitate backwards

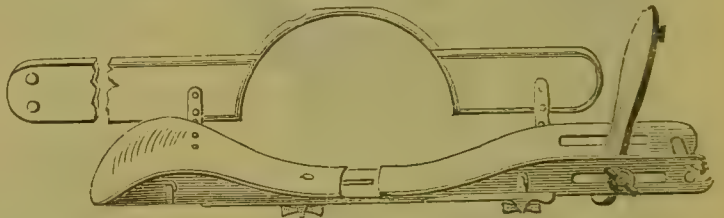


FIG. 426. Splint for excision of the knee.

(which is also assisted by the action of the flexor tendons); and it is at any rate a useful precaution to apply a long side-splint to the outer side of the limb, which can be discarded after the first few days if it appears superfluous. I have found much comfort to the patient from suspending the whole apparatus in a 'Salter's swing.' It will of course be understood that the splints are interrupted and bracketed with iron at the seat of operation, so as to give access to the wound.

Mr. Treves, of Margate, thus describes a method of excising the knee, in which the tendon of the quadriceps extensor is left in its natural attachment to the tibia. I have myself no personal experience of this method, but it seems worthy of a trial:—

'*First.* A semilunar incision about three inches in length is made on each side of the joint, the lowest point of each incision being thoroughly dependent for the exit of pus or serum.

flap leaves a hollow cavity, in which matter bags, and requires a separate incision to drain it efficiently.' ('On Excision of the Knee,' p. 76.) If the latter assertion be well founded, it constitutes to my mind an additional objection to the use of the long flap in excision rather than an argument for the preservation of the patella. None of the other supposed inconveniences of removing the patella will be found to be of any practical importance if the operation be performed with the simple transverse incision. As to the first assertion, it is a matter of experience. In my own practice the removal of the patella has seemed in the great majority of cases not merely advisable, but necessary.

'*Secondly.* The lateral ligaments on each side are divided, and the tissues reflected, till the synovial cavity in front is well opened. If there be adhesions in front they are divided. A wide director is passed behind the joint in front of the posterior ligament, and with a narrow bistoury the crucial ligaments and any adhesions there may be between the bones are divided.

'*Thirdly.* A metal retractor is inserted in front of the bones to secure from injury the tissues in front, and the skin and tissues loosened from the sides whilst the bones are being sawn. The blade of a Butcher's saw is passed behind the joint; and this being connected with its frame, a thin slice is sawn from the joint-ends of each bone. The sawn surface of this slice is the exact counterpart of the surface left behind; and if, on examination, it appear to be healthy, I pass on to the patella, which is left if healthy, or sliced if its cartilage be ulcerated. I formerly used a chain-saw for the sections, but have relinquished it in favour of Butcher's.

'The following are the chief advantages to be derived from this mode of operating:—

'1. Decided improvement in the after-appearance of the limb. The front view shows little difference from the other limb.

'2. Greatly increased power of extension. After ordinary excision, extension is often feeble from the divided and shortened extensor tendon; the leg is inclined to drag, and the patient catches his toe in walking. With this operation, they are able to lift the leg even before union is firm; and they get increased advantage from the additional power and handiness of the limb.

'3. The extensor tendon being still attached to the tibia in front, whilst the posterior ligament is intact behind, the bones are not so loose and the tibia is not so likely to become displaced.

'4. This mode of operating partakes of the nature of a subcutaneous operation. The sawn surfaces are still left under their natural covering; they are not exposed under an extensive wound, which will sometimes gape in spite of care; but, being well protected, they unite, I believe, more kindly and readily than with the usual operation. I may add that this is, after a little practice, a very easy operation.'¹

In an interesting brochure lately published by Dr. Fenwick of Montreal,² which contains a report of twenty-eight cases of this excision, he advocates a curved section of the bones, so that the sawn end of the femur is left convex and that of the tibia concave, whereby not only are the bones better adapted to each other, and less likely to become displaced, but also the epiphysial lines are nowise endangered. A similar plan was, I believe, adopted by the late Mr. Moore and Mr. Campbell de Morgan. Mr. R. Davy³ modifies the operation by performing what he terms 'tibio-femoral impaction.' Having removed the ends of the bones, he 'cuts a mortise in the head of the tibia and shapes the femur as a tenon; he then places the femur in the head of the tibia, and applies direct pressure to the foot, until impaction results up to fixity of tenure.' Other surgeons adopt the practice of suturing the femur and tibia together, either with catgut or silver, holes being made with a drill on each side of both bones. And others again peg the bones together with a drill, the end of which is left sticking out of the wound and can be removed, when the object for which it was introduced has been obtained.

Many methods of dressing the wound and limb in cases of excision of the

¹ 'Brit. Med. Journ.' Feb. 3, 1877.

² 'On Excision of the Knee Joint,' Montreal, 1883.

³ 'Brit. Med. Journ.' Oct. 20, 1883, p. 758.

knee are in use. Dr. Patrick Heron Watson warmly recommends the use of plaster of Paris (or plaster coated with paraffin externally, to render it less permeable to discharges), which he thus applies. Fig. 427 represents an iron rod, which extends from the groin to the foot, the upper straight end being at the groin, the arch at the site of the wound, the hook (for swinging the limb) near the ankle joint, and the raised part running along the dorsum of the foot. Fig. 428 shows two forms of 'Gooch' splint, the upper merely hollowed out on each side at the level of the wound and cut out at the lower part in a horseshoe or stirrup form, to relieve the heel and tendo Achillis



FIG. 427. Dr. P. H. Watson's suspension-rod for excision of the knee.

from pressure; the lower having also a piece above to be adapted to the innominate bone.

'In application, the limb is first laid and carefully adjusted upon the posterior splint, which should preliminarily be padded with lint, and covered with gutta-percha tissue, or hot paraffine, in the position which corresponds to the site of operation. The iron rod is then placed in front, and folded lint laid between it and the limb at the groin, at the upper part of the tibia, and at the bend of the ankle. These two parts of the apparatus are then retained in contact with the limb by means of an *open wove* roller bandage applied from the toes upwards, the site of the incision being alone left uncovered. The whole is then rendered immovable by means either of plaster of Paris applied by the hand, of the consistence of thick cream, or of paraffine, which,

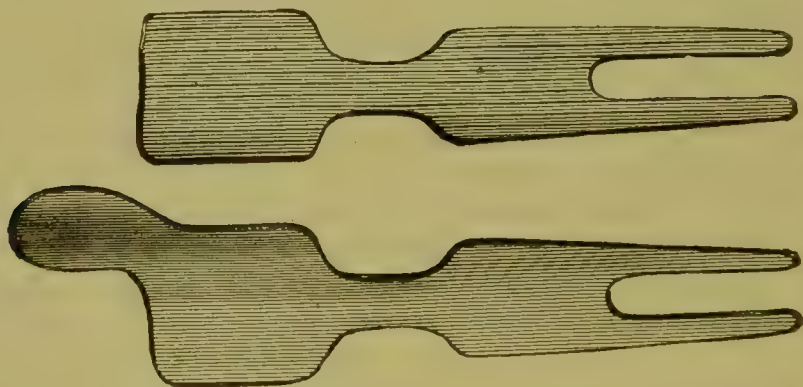


FIG. 428. Dr. P. H. Watson's splints for excision of the knee.

having been rendered temporarily liquid by heat, is applied by a large painter's brush. When the application has solidified, the patient may be removed to bed, and the limb suspended from the running pulley of a Salter's swinging cradle, or from the roof-bar of the common iron wire cradle.' (Op. cit. p. 19.)

The advantages claimed for this method are the comfort the patient derives from being able to shift his position; the ease of transporting him from place to place (a great consideration in military practice); the facility of applying dressings to the wound; the permanency, simplicity, and facility of construction of the apparatus itself. The plaster-of-Paris dressing is in general use in this and other excisions by the German surgeons.

Mr. Butcher has recommended¹ a 'box splint' for the after-treatment of

¹ 'Operative and Conservative Surgery,' p. 142.

this operation. This consists of two side-splints, the outer one extending from the axilla to below the foot, the inner from the groin to below the foot, jointed on to a back piece. The sides are let down to dress the wound. This is, as far as I have seen, a convenient apparatus when all goes well, but is less handy when complications occur, and is, on the whole, I think, inferior to the above-mentioned methods of treatment.

It is an essential element in the success of this operation not to be forced to disturb the limb at all for several days; hence the dressings should be most carefully applied at first. And for the same reason all bleeding vessels should be carefully secured so as to avoid reactionary hæmorrhage. The bleeding during the operation is often very free, from the enlarged articular vessels; and reactionary hæmorrhage is by no means rare, and is a very unfavourable occurrence. The result of the operation will depend mainly on the successful prevention of decomposition in the discharges. Formerly the operation, especially when it had been a protracted one, which in cases of old dislocation it often is, was usually followed by a considerable amount of fever, subsiding with the establishment of a free suppuration; and then, in favourable cases, the work of repair commenced by granulation and osseous union, as in compound fracture. At the present day, however, with great care and cleanliness and the adoption of antiseptic precautions, the cases usually run a very different course than this, and matters go on much more rapidly. In Dr. Hodge's tables the average duration of the treatment in 48 cases in which the patella was removed is stated to have been 225 days; and in 38 cases in which that bone is believed to have been left, 255 days; or roughly speaking, the average duration of treatment was about eight months; and in many of the cases which afterwards turned out the most successful, sinuses remained open and the limb was in a state which could not but cause anxiety for many months after formal treatment was discontinued. Nowadays it is no uncommon thing to see recovery completed as soon as after amputation, the wound healing without suppuration and the patient about on crutches, with his limb in some fixed apparatus, within a month or six weeks of the date of the operation.

Repair, when the case does perfectly well, is by osseous ankylosis, and this ought to be complete, so that the tibia and femur form one solid mass of bone in a perfectly straight line.¹ There is a great tendency to bow outwards at the junction, and this must be carefully watched and counteracted during the process of healing, and for some time after the patient begins to put his leg to the ground. In rarer cases the limb bends backwards² or inwards, but the outward bend is the more common. In some cases small portions of bone remain long exposed, and the wound cannot be brought to heal. Such cases may often be treated successfully by gouging or by treating the exposed bone with sulphuric acid. In unfavourable cases the bones become denuded and ulcerated in the suppurating cavity, the discharge is offensive, the wound unhealthy, fresh abscesses probably form, and the patient's health, instead of improving from the removal of the disease, shows a tendency to decline. Under these circumstances amputation should be performed, if an examination under anæsthesia proves it necessary.

¹ Cases sometimes occur in which a certain amount of motion is preserved, and Mr. Annandale has reported a remarkable one in the 'Brit. Med. Journ.' April 21, 1877, but I think no one now doubts that the aim of the surgeon should be to obtain osseous union.

² As in a preparation in the museum of the College of Surgeons, where bony ankylosis has taken place at a right angle.

Excision of
the ankle.

Excision of the ankle joint is an operation which is not often practised, since in injury it is usually sufficient to take away the loose or comminuted portions of bone, and in disease the affection is seldom so limited to the ankle as to justify the surgeon in removing only that joint.

Cases suitable for excision of the ankle are those in which the lesion (whether traumatic or from disease) is limited to the ends of the bones of the leg and to the astragalus. When the disintegration extends far into the bones of the leg, amputation ought undoubtedly to be practised, and although in some cases a considerable amount of the bones of the tarsus has been successfully removed along with the ankle joint,¹ yet the advisability of such an operation must always be very doubtful. Again, the patient ought not to be labouring under any general constitutional cachexia; and further, those cases are best suited for this excision in which the disease is the direct result of a somewhat recent injury. With all these limitations, the range of application of this operation will be but small in cases of disease, and in those of injury, as above stated, partial resections have hitherto been more common; but there is much reason to believe, with Mr. H. Lee, that in these cases a more useful limb would often be obtained by a more formal excision of the whole joint.²

The operation is not an easy one, and it is rendered more difficult in some cases by partial ankylosis. The best way of performing it is, I think, to make a free incision behind the posterior border and external malleolus of the fibula, extending about two inches along the outer side of the foot, and a smaller incision, as recommended by Mr. H. Lee (*op. cit.*), round the internal malleolus. The inner malleolus, having been carefully cleaned of soft parts, is to be partially sawn through with a Hey's saw, and clipped off with bone-nippers. Then the external malleolus, having been dissected clear of the tendons and other fibrous structures, is to be sawn through, and now, by clearing the bones of all their fibrous adhesions, the tibia may be pushed out of the wound on the outer side of the foot, and its articular end sawn off. Next the astragalus is to be dealt with. In all cases where the bone is much inflamed it is much more satisfactory (as I think I have proved³) to remove the whole bone, for which purpose the astragalo-scapoid joint should be freely opened; then the knife passed between the astragalus and os calcis, dividing the interosseous ligament; and finally the bone twisted out with the lion-forceps. But if the affection of the astragalus be very superficial, a keyhole saw may be passed into the wound, either in front of or behind the articular surface, and the whole of this surface removed by a horizontal section. No large vessel should be wounded in this operation, nor are any tendons necessarily divided.

A much easier operation is to make an anterior flap through all the tendons, nerves, and vessels in front of the joint, as in Syme's amputation, and then remove all the diseased parts of the bones; but as this involves needless injury to the anterior tibial vessels, and division of several tendons, it is not often resorted to. At the same time, I have excised both the ankle joint and the astragalus in this way several times, and the use of the foot has been very good, notwithstanding the injury to the tendons and vessels. In cases of partial ankylosis especially, this plan should, I think, be followed.

¹ See my essay, 'On Excision of Bones and Joints,' in the 'Syst. of Surg.'

² See a paper by Mr. H. Lee in 'Med.-Chir. Trans.' vol. lvii. p. 137.

³ See 'St. George's Hospital Reports,' vol. iv. 'A Note on Excision of the Ankle Joint.'

A method of excising the joint through a posterior incision, dividing the tendo Achillis, is described by Liebrecht,¹ but I have no experience of it. The tendon is sutured after the completion of the operation.

A well-fitting splint should have been previously provided, and the limb should be kept at rest till the parts have become quite consolidated. It is then to be put into a plaster or other immovable apparatus, and the patient is to be allowed to walk about on a wooden leg.

The use of the leg is often almost as good as ever. Two lads on whom I performed this operation, removing the astragalus wholly in one and partially in the other, were heard of some years afterwards doing the ordinary work of agricultural labourers, and able to walk all day; but recovery is much slower than after amputation.

Excision of the os calcis is an operation which may often be practised with great advantage. Disease of the tarsus very commonly begins in the joint between the calcaneum and astragalus, and frequently spreads into the former bone; the affection of the latter being so superficial that the carious spot can be gouged away when the greater mass of disease has been removed. In these cases the central part of the calcaneum often perishes, leaving a large mass of necrosis enclosed in a thin-walled cavity of inflamed and softened bone. If now the whole bone, including the shell of softened bone, be removed, the patient makes a certain and speedy recovery with a useful foot; while if the loose portion be removed, and the shell scooped, he may, it is true, recover, and the heel may possibly be more firm, but the recovery is at least doubtful, and in the course of a tedious convalescence the health may give way, fresh disease be lighted up, and amputation become necessary.

Excision of
the os
calcis.

Excision of the os calcis is thus performed. An incision is commenced at the inner edge of the tendo Achillis, and drawn horizontally forwards along the outer side of the foot, somewhat in front of the calcaneo-cuboid joint, which lies midway between the outer malleolus and the end of the fifth metatarsal bone. This incision should go down at once upon the bone, so that the tendon should be felt to snap as the incision is commenced. It should be as nearly as possible on a level with the upper border of the os calcis; a point which the surgeon can determine, if the dorsum of the foot is in a natural state, by feeling the pit in which the extensor brevis digitorum arises. Another incision is then to be drawn vertically across the sole, commencing near the anterior end of the former incision, and terminating at the outer border of the grooved or internal surface of the os calcis, beyond which point it should not extend, for fear of wounding the posterior tibial vessels. If more room be required this vertical incision may be prolonged a little upwards, so as to form a +.² The bone being now denuded, by throwing back the flaps, the first point is to find, and lay open, the calcaneo-cuboid joint; and then the joints with the astragalus. The connections between these two bones constitute the principal difficulty in the operation on the dead subject; but, as has been already stated, these joints will frequently be found to have been destroyed in cases of disease. The calcaneum having been separated thus from its bony connections by the free use of the knife, aided if necessary by the lever, lion-forceps, &c., the soft parts are

¹ 'Annales Med. Chir.' 1885, No. 1.

² I have always divided the tendons of the peroneus longus and brevis. They can, of course, be dissected out and held aside with a blunt hook, but I have not observed any bad effects from their division.

next to be cleaned off its inner side with care, in order to avoid the vessels, and the bone will then come away. The flaps are to be closed lightly, with one or two points of wire-suture, over the large gap left by the excision.

Subperiosteal excision.

M. Ollier describes an operation by which the os calcis can be removed subperiosteally without the division of any tendons, except the tendo Achillis. An angular flap is made by an incision running horizontally along the lower outer border of the bone, and vertically along the outer border of the tendo Achillis. Then the periosteum and the parts above it, including the peronei tendons, are peeled off the bone. Next the attachment of the tendo Achillis and the periosteum are detached from the tuberosity of the os calcis. Then the joints are opened, and the inside of the bone is cleaned, and so its removal is completed. I have only practised this operation once, and then the result seemed to me less perfect than after the ordinary operation.¹

After recovery, the only mark of deformity in the foot is an elevation of the heel proportionate to the size of the bone removed.

Excision of the astragalus.

Excision of the Astragalus.—The astragalus is easily removed by making a curved incision from one malleolus to the other, something like that made at the beginning of Syme's amputation. The ankle joint is then to be laid freely open, and the whole upper part of the diseased bone thus exposed. Then the ligaments connecting it to the scaphoid are to be severed, and the bone is to be levered up, when the interosseous ligament connecting it with the os calcis will, if entire, be felt, and can be readily divided. All that is then necessary to complete the operation is to clean the back part of the bone, which should be done with care, in order to avoid injury to the tendons and vessels which lie near it. I have had several cases in children, and have seen one in an adult in whom a very useful foot was left.

The bone may also be removed by two lateral incisions similar to those used in excision of the ankle. This method avoids the injury to the tendons and vessels incidental to the former, but is more laborious.

Excision of the astragalo-calcaneal joints.

Mr. Annandale has lately devised and performed an operation by which the joints between the astragalus and os calcis can be excised in those cases where disease of the tarsus begins, as it often does in that situation. A free incision is made from the tip of either malleolus to the cuboid joint on the one side, and along the tendon of the tibialis posticus to the scaphoid bone on the other. The tendons and vessels are thrown back, and the periosteum raised from the bones with raspatories. Thus the two joints are fully exposed, and can be removed with chisel and mallet. If there be any disease in the fossa between the two joints, it can be gouged out. Mr. Annandale refers to cases in which the operation has been successfully performed.²

Miculicz's resection.

In cases where the astragalus and os calcis are both diseased, and the soft tissues of the heel destroyed or spoilt, Miculicz³ has devised an operation by which he removes the diseased structures, leaving the anterior part of the foot. The operation consists in the removal of the os calcis and astragalus, along with the articular surfaces of the tibia and fibula, and also of the scaphoid and cuboid. The remaining portion of the tarsus is then brought

¹ See 'Clin. Soc. Trans.' vols. viii. xi.

² 'Ed. Med. and Surg. Journ.' June 1877.

³ See a case by Sir Wm. MacCormac, 'Lancet,' May 5, 1883.

into contact with the sawn surfaces of the tibia and fibula and fixed there. The result is a position of the shortened foot resembling *talipes equinus*.

No formal directions are required for excising the other tarsal bones. The soft parts are to be thrown aside by crucial incisions, radiating from the sinuses which lead to the diseased bone, and the latter removed; care being taken, in all cases where it is possible, to excise the whole bone with the articulating surfaces.

Other excisions in the foot.

The metatarsal bone of the great toe is very often diseased; and from its large size disease may go on in its substance for a long period without affecting any other bone. In such cases, after a sufficiently patient trial of the appropriate constitutional treatment, with rest, it is proper to expose the disease; and if this is found to include the greater part of the bone, then the best course is to remove the whole, with both its articular surfaces. This may be readily done by making an incision over the whole length of the bone, joined by shorter perpendicular cuts in front and behind, and thus turning back small rectangular flaps including the whole length of the bone. It is better to commence by severing it from the cuneiform bone, as in dividing it from the phalanx the plantar arch will most likely be wounded, and the bleeding may prove somewhat embarrassing; whereas if the artery be not divided till the bone is removed there is no difficulty in tying it. No splint is required. The great toe sinks down somewhat towards the tarsus, but the foot is as useful in progression as before.

It seems hardly worth while to expend space on the description of such rare operations as the excision of the whole or greater part of the tarsus,¹ of the tarso-metatarsal joints,² or of portions of the whole of the shaft of the long bones or of the ribs or sternum. They are very rarely practised, and in the latter case especially the indications for their performance should be narrowly scrutinised, since they are by no means free from danger, nor at all certain to attain the end in view, which is to remove the whole disease and thereby take away permanently what must always be a source of irritation to the subjacent viscera.

¹ On excision of the whole tarsus see Macnaughton Jones, 'Lancet,' July 9, 16, 1881; and Conner, 'Am. Journ. Med. Sc.' Oct. 1883.

² See a case reported by me in the 'Clin. Soc. Trans.' vol. v. p. 207. Disease recurred in the tarsus in this case eight years afterwards, and the foot was amputated.

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